INDEXED

Marine Engineering

Vol. IX. JUNE, 1904. No. 6

PATENT OFFICE

THE LATEST UNITED STATES BATTLESHIP LAUNCHED—THE VIRGINIA, OF 15,000-TONS DISPLACEMENT.

Length over all, 435 feet; breadth, extreme, 76 feet 2 1-2 inches; draft, normal, 23 feet 9 inches; speed, 19 knots; I. H. P., 19,000.

Armament: four 12-in. B. L. R.; eight 8-in. B. L. R.; twelve 6-in. R. F. G. Secondary battery, 42 guns.

Armor: belt, 11 to 8 inches; casemate, 6 inches; turrets, 12 and 6 inches. Complement, 800 men.

[Photograph by Muller.]

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MAIN DECK

GUN DECK

SUPPLEMENT TO MARINE ENGINEERING, JUNE, 1905.

INBOARD PROFILE AND DECK PLANS OF THE 15,000-TON UNITED STATES BATTLESHIP VIRGINIA, AND CLASS, BUILT BY THE NEWPORT NEWS SHIPBUILDING AND DRY-DOCK COMPANY.

THE UNITED STATES BATTLESHIP VIRGINIA.

On the fifth day of April, in the presence of thousands of spectators, before the governor of the state of Virginia and his staff, members of the legislature, and many distinguished visitors, the United States battleship No. 13, the *Virginia,* was launched at the works of the Newport News Shipbuilding and Dry-Dock Company. The *Virginia* is the first to be launched of the five battleships appropriated for by the acts of Congress of March 3 and June 7, 1899, her sister ships being the *Nebraska, Georgia, New Jersey,* and *Rhode Island.* She represents the highest development of the battleship at the time the contract for her construction was made, and she is of a powerful and well-balanced design.

With a load water-line length of 435 feet, an extreme breadth at load-water line of 76 feet 2 1-2 inches, a mean trial draft of 23 feet 9 inches, and a trial displacement of 14,950 tons, she is, at present, the largest United States battleship off the stocks. She was built on the designs of the Navy Department as to hull and machinery, the details being worked out by the contractors, but all subject to the Department's approval. She is required on trial to make an average sea speed of 19 knots an hour for four consecutive hours, and there are the usual penalties for under speed and delay in delivery.

The *Virginia* is a twin-screw, first-class battleship, built of steel, having a double bottom and well divided into water-tight compartments.. In general appearance she resembles others of the more recent battleships, differing from some, however, in that her after body is carried to the same height as the forward body, thus securing more freeboard aft, raising the after turret to the same height above the water line as the forward turret, thereby increasing the efficiency of the after guns and adding greatly to the comfort of the living quarters in the after part of the ship. There are two steel military masts, with upper and lower fighting tops, signal yards, and search light platforms, and there are three smoke pipes.

ARMAMENT.

The armament of the *Virginia* class is noticeable in that its design shows a return to the 8-inch rifle, which had been omitted in the *Illinois* and *Maine* classes, immediately preceding this. In the two former classes there was no intermediate size between the 13- or 12-inch turret guns and the 6-inch broadside guns. The main battery of the *Virginia* consists of four 12-inch, 40-caliber B. L. R., eight 8-inch B. L. R., and twelve 6-inch R. F. G. Compared with the four 13-inch and fourteen 6-inch guns of the *Alabama,* or the four 12-inch and sixteen 6-inch guns of the *Missouri,* it would seem that the *Virginia* has a much superior battery to the earlier ships, though the increase has entailed a considerably greater displacement. The total estimated weight of guns, mounts, and shields is 5 1-2 per cent. of the displacement.

There is a powerful secondary battery consisting of twelve 3-inch rapid-fire guns, twelve 3-pounder semi-automatic, four 1-pounder heavy automatic, four 1-pounder heavy rapid fire, two 3-inch field pieces, two .30-caliber machine, and six .30-caliber automatic guns; there are also two submerged torpedo tubes.

ARMOR.

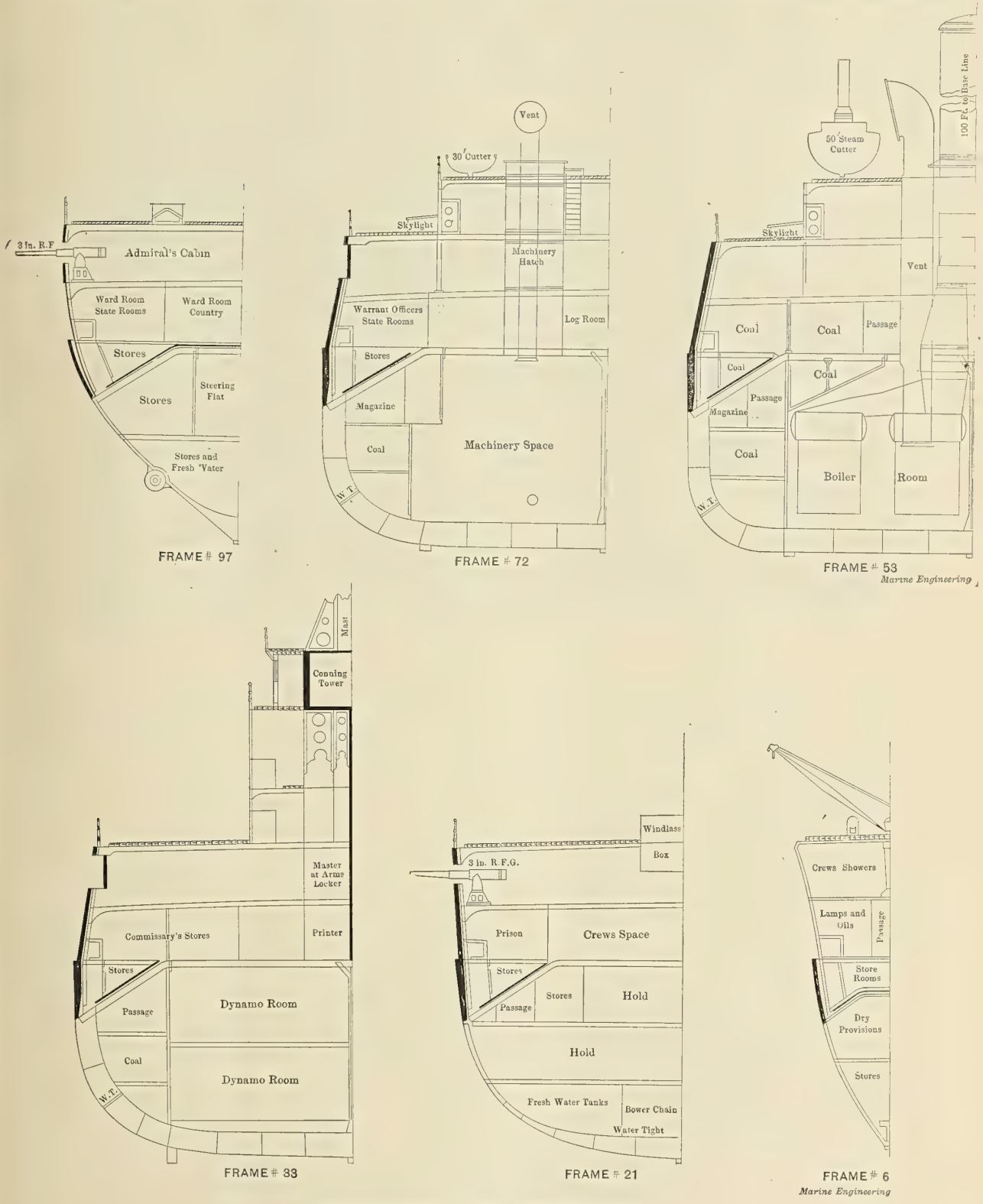
The armor, furnished by the government, is placed and secured by the contractor. All the armor is face hardened, that over 5 inches thick by the Krupp process, that 5 inches or less by the Harvey process. There is a complete water-line armor belt, 8 feet deeep, and extending from stem to stern. For the length of the machinery space, amidships, this belt is 11 inches thick from the top to within about 3 feet from bottom, from which point it tapers to 8 inches. From the limits of the machinery space to the bow and stern the water-line belt is reduced in thickness, in four courses, as follows: first, 9 inches tapering to 6 inches; second, 6 inches tapering to 4 1-2 inches; third, 5 inches tapering to 4 inches; fourth, uniformly 4 inches to bow and stern of the ship. Above the heaviest part of the water-line belt and extending up to the main deck, the ship is protected by casemate armor 6 inches thick, while running athwartships, from the after end of casemate armor to the after barbette, and directly across the ship about four frames forward of the forward barbette, is a wall of armor 6 inches thick, thus forming a central citidal.

Within this casemate, on the gun deck, six on a side, are placed the 6-inch broadside guns, each gun being isolated from its neighbors by 2 1-2-inch and 1 1-2-inch armor. The barbettes of the 12-inch guns are 10 inches thick in front reduced to 7 1-2 inches in thickness in the rear, and the turrets are 12 inches thick. The 8-inch turrets, one of which is superposed on each 12-inch turret, the other two being placed, one on each beam, a little forward of amidships, are formed of 6-inch armor, with 6 1-2-inch port plates. All turrets are elliptical and balanced, and have inclined fronts. Each is turned by an electric motor placed directly below the turret. Each turret also has a washing-out system for each gun and an electric smoke blower for blowing the smoke and gases from the bore of the guns. The total estimated weight of the protection is 25.2 per cent. of the displacement.

The protective deck, between the athwartship casemates, is formed of two courses of 30-pound steel plates, to which is riveted on the slope a 1 1-2-inch nickel steel plate, making the total thickness 3 inches. At bow and stern this deck slopes down to below the water line and is firmly secured to the stem and stern castings. There is also a 3-foot coffer dam, packed with cellulose, extending the whole length of the vessel on each side above the protective deck. The conning tower is 9 inches thick, and the armored tube 5 inches thick, and there will also be a signal tower with walls 5 inches thick. The magazines are below the protective deck and so arranged that about one-half the ammunition shall be stowed at each end of the ship.

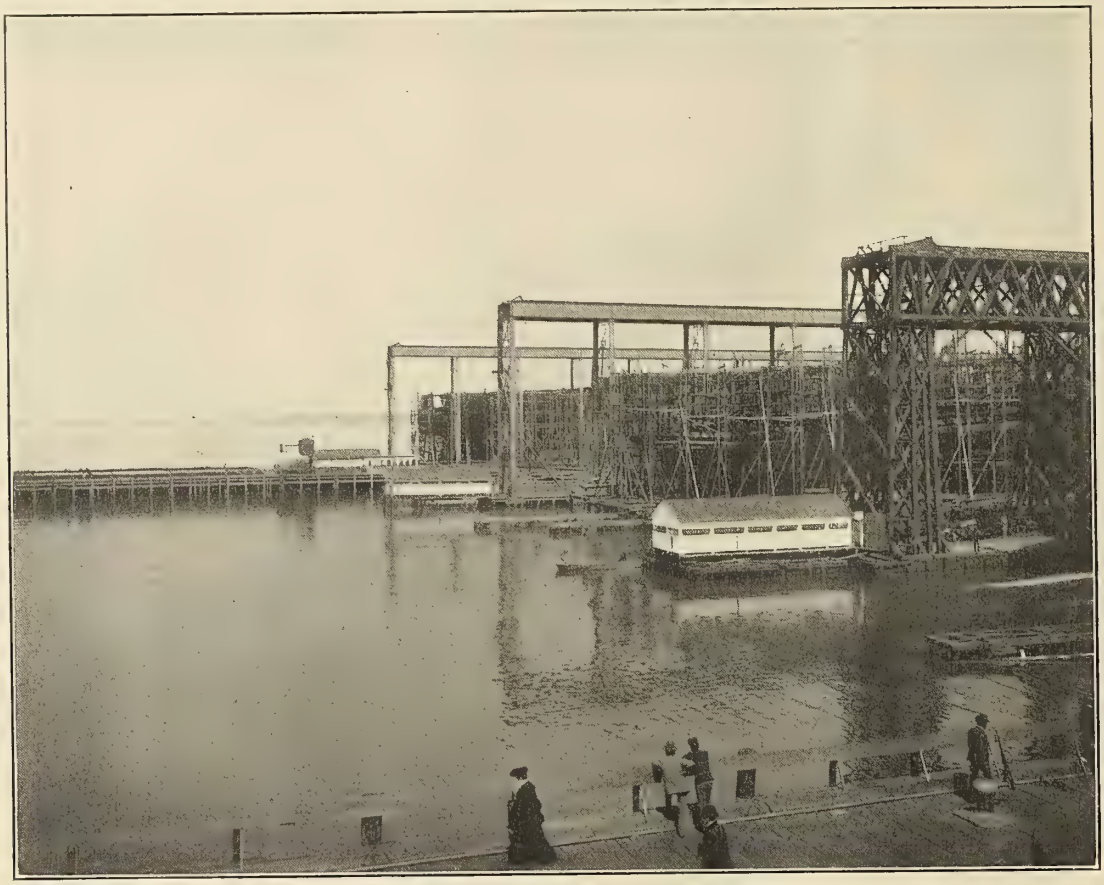
In such a vessel as the *Virginia,* where the battery is composed of so many rapid-fire guns, the ammunition supply must be ample and reliable. Leading fore and aft from the magazines, on each side of the ship, is an ammunition passage, and at proper intervals, so placed as to be conveniently near the guns to be supplied, are electric ammunition hoists of 2 1-2 or 3 horse power each. The ammunition is conveyed along these passages by trolleys until it reaches its proper hoist, near which is a ready-service magazine, where it is held until needed, when it can be quickly placed on the hoist and raised

to the gun. There will be racks near the 6-inch guns of sufficient capacity to stow at least one-tenth the full a charge to the loading position in ten seconds. The rate at which ammunition shall be supplied to the guns



SECTIONS OF UNITED STATES BATTLESHIP VIRGINIA.

supply of shell for each gun. The ammunition for the turrets is supplied by electric hoists leading direct from the handling rooms to the turrets and capable of hoisting is as follows: for each 12-inch gun, one round every 90 seconds; for each 8-inch gun, one round every 50 seconds; for each 6-inch gun, one round every 10



LAUNCHING THE UNITED STATES BATTLESHIP VIRGINIA FROM THE YARDS OF THE

seconds; for each 14-pounder, one round every 4 seconds; for each 3-pounder, one round every 2 seconds, and for each 1-pounder, 100 rounds a minute.

On the extreme forward part of the gun deck are located the waterclosets and shower baths for the crew; the space between turrets on this deck is occupied by the 6-inch broadside battery, abaft which, on each side of ship, are offices for the admiral—for the ship is fitted as a flagship—captain, navigator, and ordnance officer, state rooms and lavatory for the captain and chief-of-staff, and six ward room officers' state rooms, while still further aft is the admiral's cabin, state room, reception room, lavatory, and after-cabin, and the captain's cabin. These quarters are all commodious and roomy and conveniently arranged.

On the berth or protective deck, forward, are store rooms, the dispensary, operating room, and sick bay; also crew's space, prison, band room, and quarters for machinists and petty officers. Abaft the forward turret, on the port side, is a refrigerating plant and ice machine, as described elsewhere; on the starboard side a laundry, and, at the conning-tower tube a printer's room. Abaft this for about 120 feet are coal bunkers on each side, separated from the boiler hatches by fore-and-aft passages; at the after end of boiler hatches is the evaporator room. The rest of this deck, to the after turret, is taken up by junior and warrant officers' state rooms and dining room, and abaft the after turret is the ward room. The total complement of officers and crew will be about 800 men.

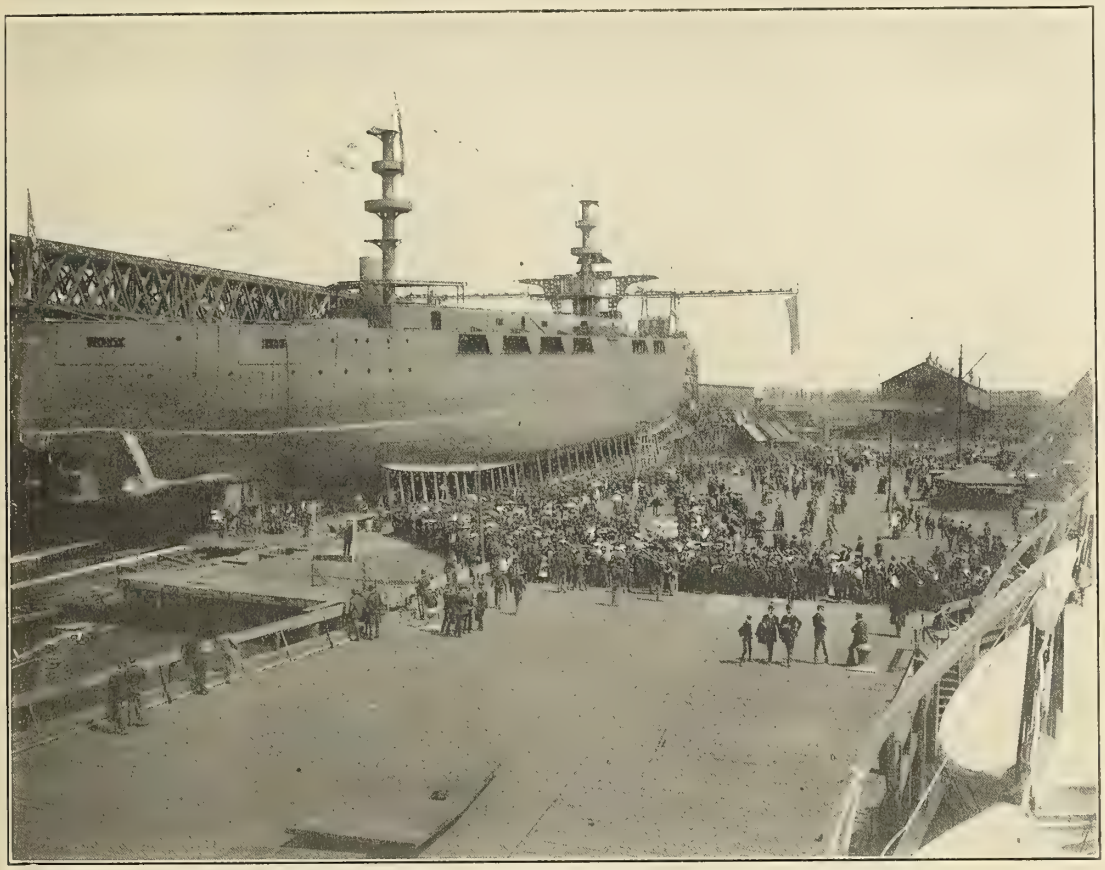
Below the protective deck, as previously stated, are the magazines, shell rooms, ammunition handling rooms, and passages, coal bunkers, machinery space, and various store rooms.

DRAINAGE.

There is a very complete drainage system for salt and fresh water and also flooding pipes for magazine, shell rooms, and trimming tanks. The main drain proper, a 15 1-2-inch galvanized steel pipe, runs from the forward boiler rooms to the engine room with a valve in each machinery compartment. The main circulating pumps and all the principal steam pumps connect to this pipe. There is a 5 1-2-inch auxiliary drain pipe, connecting manifolds forward and aft, from which manifolds pipes lead to all the compartments to be drained; the auxiliary drain also connects to the main drain and to all steam pumps available for drainage. The valves in main and auxiliary drain pipes are worked from their own compartments and from the deck above.

MAIN ENGINES.

The installation of propelling machinery proper occupies a space 108 feet long and 50 feet wide, for the boiler rooms, and 44 feet long and 52 feet wide for the engine rooms. There is a fore-and-aft bulkhead extending the whole length of the machinery space and athwartship bulkheads, dividing the total space into eight watertight compartments, six for the boilers and two for the



NEWPORT NEWS SHIPBUILDING AND DRY-DOCK COMPANY, ON APRIL 5, 1904.

engines. The main propelling engines are right and left, one in each of the after machinery compartments. They are of the vertical, inverted, direct-acting, triple-expansion type, each with a high-pressure cylinder 35 inches diameter, an intermediate-pressure cylinder 57 inches diameter, and two low-pressure cylinders 66 inches diameter. They have a common stroke of 48 inches and are designed for a combined I. H. P. of 19,000, the piston speed, at 120 revolutions per minute, being 960 feet.

The cylinders are of cast iron, all cylinders and valve chests having working liners, and great care is taken to keep the cylinder volumetric clearances as small as possible. The clearances between pistons and cylinder heads are 1-2 inch at top and 3-4 inch at bottom. All cylinders are jacketed, steam for the jackets being taken from the main steam. The stern tube and propeller shafts are 17 1-2 inches diameter with 10 1-2 inch holes. The inboard coupling is the usual removable type, so that the shaft may be drawn out aft, through the stern tube, and there is an outboard sleeve coupling covered by a casing filled with tallow.

The bed plates, of cast steel, are in I section with fore-and-aft and athwartship girders, the latter forming seats for the main bearings. The bed plates are secured to the keelsons by body-bound steel bolts fitted with horse-shoe washers. The engine framing is of the usual, open, Bureau design, formed of steel columns and trussed by stays.

The propellers, turning inboard from above, allow the crossheads to be on the outboard side, thus bringing the working platform inboard, the most convenient location for the engineer. The thrust bearings are of the usual horse-shoe pattern with a steady bearing at each end.

The pistons are of cast steel, dished, the rods 8 inches diameter being of forged steel and hollow. The connecting rods are 96 inches between centers, four cranks long, 8 1-2 and 9 inches diameter and hollow.

The piston rod passes through the crosshead and is secured by a nut on lower end. The crosshead pins are 10 inches diameter and 10 1-2 inches long with axial holes. They are flattened 3-8 inch on each side, the flats stopping short 1 1-2 inches from ends of pins to prevent the escape of oil. The slippers are bolted to the outboard side of the crossheads. They are of cast steel, being faced on front, back, and sides with white metal 1-2 inch thick, dovetailed into recesses and hammered into shape. The ahead sliding surface is 30 by 23 inches and the total backing surface 30 by 17 inches. The crosshead guides are of cast iron, of the slipper type, hollow for the circulation of water to keep them cool, and the bearing surfaces are grooved for oil. The ahead guides are securely bolted at bottom to cast-steel strong backs of I section, which latter are secured to the outboard columns; at top the guides are bolted to the cylinders. The backing guides are bolted to flanges on the ahead guides, with tin liners between to take up wear.

The valve gear is of Stephenson type, with double bar links, and all valves are worked direct; the main cut-off is full gear, for both ends, being about .73 of the stroke.

ENGINE-ROOM AUXILIARIES.

There is one condenser on the outboard side of each engine room. The shells are of boiler plate, 7 feet inside diameter, 3-8 inches thick, and 12 feet 10 inches long between tube sheets. There are 5,684 tubes 5-8 inch outside diameter No. 18 B. W. G., and the total cooling surface for each condenser is 11,969 square feet, being 1 1-4 square foot per I. H. P. of the main engine.

There is one double, vertical-beam air pump for each engine, with two steam cylinders 14 inches diameter, two air cylinders 32 inches diameter and stroke 21 inches.

For each main condenser there is a 45-inch diameter runner, centrifugal, double inlet, circulating pump, driven by a compound engine 11 and 22 inches by 10 inches stroke, with cranks at 90 degrees. Each pump is capable of discharging 12,000 gallons of water per minute from the bilge when making 266 revolutions per minute. Each draws from the main drain, the engine-room bilge, and the sea, and discharges into the condenser or overboard. There is a valve in each suction pipe which is so connected by a locking device to the valves mentioned above that when one is open the others must be closed; there is also a safety sluice valve inboard of the sea valve.

In each engine room there are two main feed pumps, capable of delivering 400 gallons per minute each, and in each boiler room an auxiliary feed pump of 260 gallons capacity. In addition there is a 400 gallon fire and bilge pump in each engine room, a hot well pump of 800 gallons, which draws from the air-pump suction pipe and discharges into the feed heaters, and a sanitary and bilge pump worked from each main shaft.

In each engine room there is an auxiliary condenser with combined, horizontal, double-acting, air and circulating pump. Each has a cooling surface of 600 square feet and is connected to all the auxiliary machinery through the auxiliary exhaust pipe. There is, also, in the dynamo room, an auxiliary condenser of 1,200 square feet cooling surface for the exclusive use of the dynamo engines.

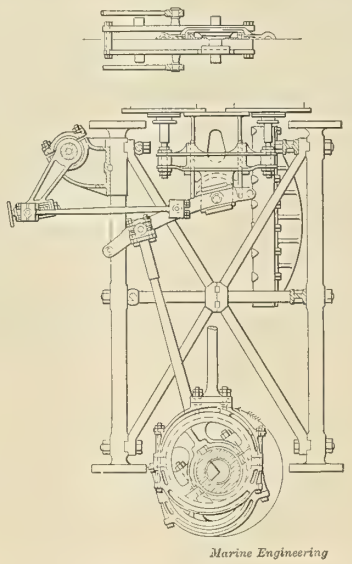
A feed heater of 950 square feet heating surface is placed in each engine room, steam being taken from the auxiliary exhaust pipe. The main feed pumps discharge through the heaters and there is a by-pass for cutting off the heater when not in use.

There is a combined feed and filter tank in each engine room, underneath the condenser, of a total capacity of 4,800 gallons. The tanks are of 1-4-inch galvanized steel, well braced internally, and having openings in the filter chamber for the discharges from the main and auxiliary air pumps, hot well pump, and an overflow pipe, drain pipes, etc. The outlet to feed and hot well pump suctions is controlled by a balanced float valve.

BOILERS.

Forward of the engine room is a 12-foot coal bunker through which, on each side of the center line bulkhead, a 4-foot passage gives communication between the engine and boiler compartments and affords space for running pipes, etc. Forward of this athwartship bunker are the six boiler compartments, three on each side of the ship, flanked on their outboard sides by coal bunkers, as shown the sections on page 251. In each of these six compartments are placed four water-tube boilers, with tubes running fore and aft. These boilers are of the usual Niclausse type, the outboard boilers having 15 elements, the inboard 16 elements each, and each boiler has three furnace doors. The total grate surface is 1,280 square feet and the total heating surface about 57,000 square feet. The grates are 6 feet 9 inches long and the tubes 7 feet 5 3-4 inches long. The boiler drums are 42 inches diameter.

As the indicated horse power, on trial, of the auxiliary machinery on large battleships is about 4 per cent. that of the main engines, the boilers here are required to develop a total of about 15 1-2 I. H. P. per square foot of grate.

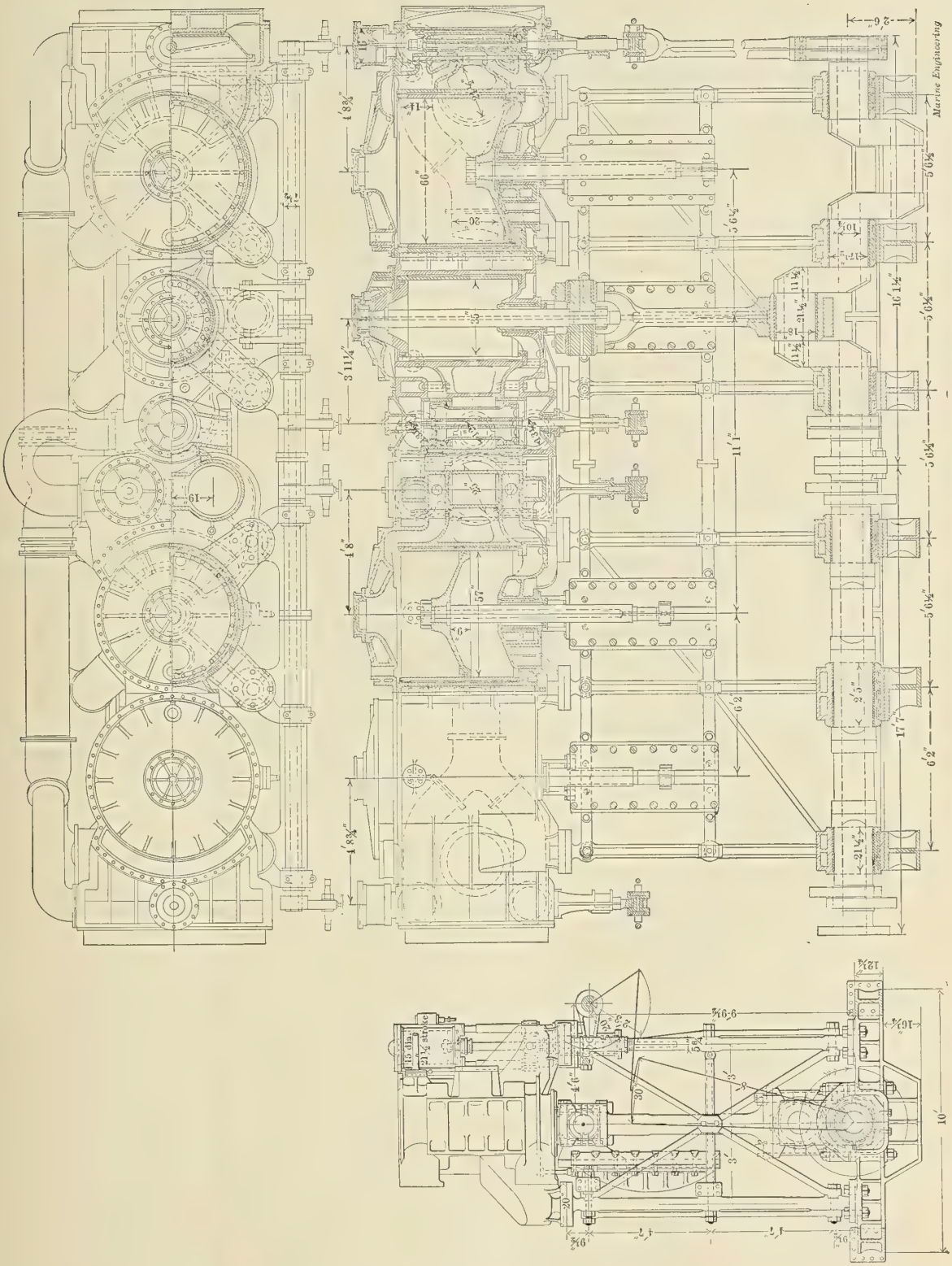


VALVE GEAR AND FRAMING. PORT ENGINE, LOOKING AFT.

The closed fire-room system of forced draft is used, the necessary air being supplied to each compartment by two steam-driven blowers, 42-inches diameter, and of sufficient capacity to maintain an average air pressure in the ash pits of 1 inch of water at not more than 500 revolutions per minute. The coal bunkers are arranged with reference to the rapid and efficient supply of coal to the fire rooms and have a normal capacity of 900 tons.

One of the noticeable features in this ship is the large capacity of the evaporating and distilling plant, being respectively 19,000 gallons and 10,000 gallons of water per 24 hours. There are four evaporators of 240 square feet heating surface each and three distillers. The evaporators are arranged to work in pairs, double effect. The following pumps are run in connection with the plant: distiller circulating pump (also used for flushing purposes), feed pump, brine pump, and fresh-water pump.

There is a very complete heating plant for heating all the living quarters of the ship, as well as water for bath tubs, shower baths, etc.



TRIPLE EXPANSION, FOUR CYLINDER ENGINE OF THE UNITED STATES BATTLESHIP VIRGINIA, PORT ENGINE.

H. P. CYLINDER, LOOKING FORWARD.

The refrigerating plant is of large capacity, including an ice machine capable of producing the cooling effect of three tons of ice per day. There is also a very complete work shop, with lathes, shaper, drill press, sensitive drill, milling machine, punch and shears, emery grinder, grindstone, and vise, benches, etc., all driven by an electric motor; there is also a blacksmith's forge, with all the necessary tools and fixtures.

The general tools and outfit for the ship, supplied by the contractors, include wrenches for all size nuts, tube expanders, any special tools used for the boilers, trammels and gages, hydraulic jack, fire tools for each fire room, coal and ash buckets, etc., and, in addition, when the ship goes into commission, about 40 tons of engineer's stores, including all tools necessary, will be furnished her by the government. There is also a very complete outfit of spare parts supplied by the contractor, and this includes all the important parts of the main or auxiliary machinery likely to break down.

The boilers, each length of pipe, every casting, and, in general, every item used in the machinery installation, is tested before being placed on board.

There is a fire main on each side of the ship through the machinery space and below the protective deck. From this main vertical risers pass up the hatches where required and end in hose connections for the attachment of fire hose or connections for washing decks. All couplings are for the 2 1-2-inch standard navy hose.

There is a very complete ventilating system. Unlike preceding ships, in which the ventilation was provided by a small number of large blowers, located in blower rooms, the *Virginia* has no less than thirty-five ventilating blowers located in various parts of the ship, but mostly on the berth deck, and varying from 1-2 to 6 horse power each, the total horse power being about 75. These blowers are all electric and the air supplied is led to the proper compartments through ducts of ample size. There is steam steering gear and windlass, also two hand-power capstans. On the main deck forward are three cranes for the anchors. On top of the superstructure, which encloses the space between the turrets on this deck, are four boat cranes for swinging the boats into position; there are also davits for harbor use, and all davits are arranged to turn down. The following boats are carried: one 16-foot and two 20-foot dinghys, four 30-foot cutters, one 30-foot barge, one 30-foot gig whaleboat, two 30-foot whaleboats, two 36-foot launches, one 36-foot steam cutter, one 50-foot steam cutter.

ENGINE DATA U. S. BATTLESHIP VIRGINIA.

	H. P.	I. P.	1 and 2 L. P.
Diameter cylinders..	35 ins.	57 ins.	66 ins.
Stroke	48 "	48 "	48 "
Piston rods, diameter	8 "	8 "	8 "
Hole, diameter	1 1-2 ins.	3 5-8 ins.	5 "
Lineal clearance, top	1-2 in.	1-2 in.	1-2 in.
" " bottom.	3-4 "	3-4 "	3-4 "
Port area	165 sq. ins.	355 sq ins.	425 sq. ins.
Thickness cylinder walls.	2 ins.	1 1-2 "	1 1-2 "
" liners	1 1-2 ins.	1 3 8 "	1 1-4 "
" cyl. covers.	1 1-2 "	1 3-8 "	1 1-8 "
Con. rod L bet. centers	8 ft.	*	*
" " diam., top	7 3-4 ins.	.....	....
" " " bottom	9 ins.	.....	....
" " hole	1 1-2 ins.	4 1-2 ins.	5 ins
Crosshead pin, diameter..	10 ins.	.....	....
" " L	10 1 2 ins.	.....	....
" surface ahead..	30 x 23 ins.	.....	....
" " backing.	30 x 17 "	.....	....
Crank pin, diam	18 ins.	.....	....
" " " hole	10 1-2 ins.	.....	....
" " " length	21 1-2 "	.....	....
Thickness of crank webs..	11 1-2 "	.....	....
Lth. journal bearings	21 1-2 "	.....	....
Crank shaft, diam	17 1-2 "	.....	....
" " hole, diam..	10 1-4 "	.....	
Couplings, diameter	32 ins.	.....	
" thickness. .	3 3 4 ins.		....
Steam pipe, diameter	12 ins.	(2) 13 1-2 ins.	(2) 14 ins.
Revers. shaft, "	7 1-2 ins.	.....	....
Throw of eccentric	9 ins.	.....	....
Valve stem, diameter	3 "	3 1-2 ins.	3 1-2 ins.
Piston valves, "	20 "	(2) 22 ins.	Slide.

* Where dimensions are not given, same as H. P.

MARINE ENGINEERING DATA CARD. JUNE, 1904.

NAME—Virginia. NATIONALITY—American. TYPE—Battleship.

LAUNCHED—1904. BUILDERS—Newport News S. & D. D. Co. OWNERS—U. S. Navy.

Length on load water line .....435 ft. 0 ins.
Beam, extreme..... 76 " 2 1-2 "
Draft, mean, normal load ..... 23 " 9 "
Displacement, " " ....14,948 tons
Normal coal supply..... 900 tons
Maximum coal supply in bunkers.....1,704 "
Steaming radius, 10 knots .....3,825 miles
Speed trial.....19 knots

Batteries:
Main, 4 12-in. B. L. R., 8 8-in. B. L. R., 12 6-in. R. F. G.
Secondary, 12 3-in. R. F. G., 12 3-pd., 8 1-pd., 2 3-in. field, 8 machine.
Torpedo tubes ..... 2 submerged

Armor:
Water line belt 8 ft. deep, amidships top 11 ins, bottom 8 ins., tapering to 4 ins. at ends
Casemates..... ....6 ins.
Turrets.....12 ins. to 8 ins., 6 1-2 ins. to 6 "
Barbettes .10 " " 1-2 ins., 6 " " 4 "
Protective deck.....3 ins. to 1 1-2 "

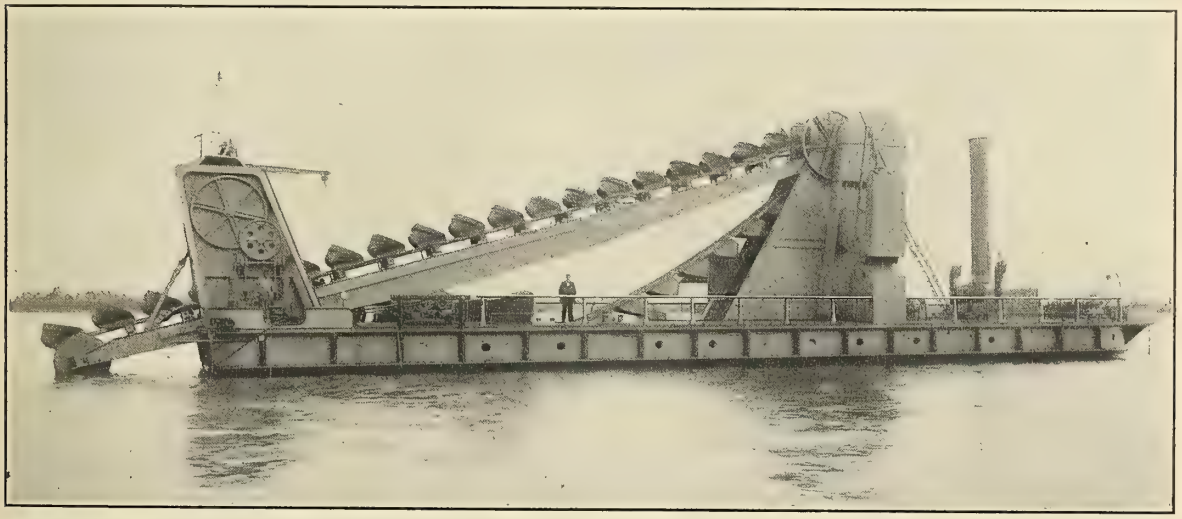
Engines.....2 sets, 4-cylinder triple
Cylinder diameters .....35, 57, 66, 66 ins.
Stroke.....48 "
Valves .....piston
Framing.....open, columns and bracing
I. H. P., designed.....19,000
R. M. P..... 120
Cooling surface, 2 condensers .....23,938 sq. ft.

Boilers: Type.....Niclausse
Number 24
G. S..... 1,280 sq ft.
H. S.....57,000 " "
Draft .....Forced closed hold

ELECTRIC LIGHTING AND POWER PLANT.

The increasing variety of uses to which electricity is applied on shipboard has led to much larger electric plants than were formerly installed. The vessel will be lighted throughout by electricity. The electric plant will consist of six 50-Kw. and two 100-Kw. steam-

driven, direct-connected generating sets, all to be of 125 volts pressure at the terminals, engines to work at 150 pounds steam pressure. The plant is located in an upper and lower dynamo room, just forward of the forward fire room bulkhead and below the protective deck. There will be about 1,030 electric fixtures, complete, with necessary incandescent lamps and outlets, 10 inclosed arc lamps in engine and fire rooms, 6 search lights mounted on platforms or bridges, as directed, 2 sets of electric night-signaling apparatus, 2 diving lamps with 150 candle-power incandescent lamps, 2 truck lights, 6 portable electric ventilating sets of 1-4 horse power, 40 1-12 horse-power desk and bracket fans, 6 1-6 horse-power bracket fans, 1 electric whistle operator, switchboards, main distribution boards, together with the necessary wire, fixtures, lamps; also instruments, tools, spare parts and stores usually furnished for the proper manipulation of such a plant. There will be the usual means of interior communication, such as telephones, voice pipes, call bells, gongs and annunciators, engine and steering telegraphs, revolution and rudder indicators, heeling indicators, automatic fire alarms, warning signals, etc.



BUCKET DREDGER OF 860 TONS CAPACITY PER HOUR, BUILT IN BELGIUM FOR AN ENGLISH COMPANY.

The Stationary Bucket Dredger Marquess.

The plate shown above is of a dredger built by the firm of A. F. Smulders, of Rotterdam, for the Cardiff Railway Company, and is of special interest, as its output reaches about 860 tons per hour.

The hull is entirely built of mild steel, according to Lloyd's highest rating for this class of vessel, and is 136 feet 3 inches long, 24 feet 7 1-4 inches wide, by 10 feet depth at the side. The thickness of bottom plates for one-half length amidships is 7-20 inch, and at ends 6-20 inch; that of side plates for one-half length amidship is 13-14 inch, and at ends 11-40 inch. The hull is provided with the necessary cabins for first and second dredging master, engineer, firemen and sailors; its after part is provided with a trimming tank, which can be used as water tank for boiler feeding when necessary. The main engine is of the horizontal compound system, with surface condenser and reversing gear. The air and circulating pumps are driven by the lengthened piston rods of the high and low pressure cylinders. The air pump is single-acting and vertical, the circulation pump horizontal and double-acting. The cooling surface of the condenser is of about 338 square feet. The tubes are of brass tinned out and inside, and fixed in the brass tube plates by yellow metal nuts. The engine is provided with a feed pump driven from the air pump crosshead. The boiler is of the usual cylindrical marine type, built of mild Siemens-Martin steel, with two furnaces. For feeding boiler, there is a donkey pump and an injector. The pump is equally arranged for deckwash and for bilge pumping.

The dredge is provided with five steam winches and two hand winches. The steam winches are: the ladder winch, two foreside chain winches, one bow chain winch, and one after chain winch. Hand winches are for raising and lowering the movable parts of the shoots. All steam winches have two cylinders. The ladder winch works with worm and worm-wheel on two pairs of cast steel spurwheels. The larger spur is keyed on the steel shaft of the cable drum, on which the steel wire ropes are wound. This winch is provided with reversing gear. The foreside chain winches are coupled in and out by friction clutches, the drums are provided with screw brakes. The bow chain winch is of the same construction as the side winches, but is stronger, has no screw brake, but rack and pinion wheel. This winch is so constructed that the paying out of chain takes place at single gearing and hauls in at double gearing. The after winch is of the same construction and dimensions as the foreside winches, excepted, that the shaft is provided with three drums, which can work all together, or each separately, as necessary.

The buckets, of a capacity of about 19 cubic feet and of eliptical form, are entirely built of mild steel, provided with strong cutting knives of Dalzell steel. The bushes and pins are of Hadfield's maganese special steel; the pins with square heads. The links are made in Dalzell steel and all bushed with the above-named manganese. The outside intermediate links are provided with noses. The upper tumbler is four-sided,

made in one steel casting, with the shaft hydraulicly pressed on and keyed afterwards. The lower tumbler is in two halves of cast iron pressed and keyed on to steel shaft. The corners of the tumbler are protected against wearing by hardened steel corner plates, and fixed on six steel corner plates. These plates are fixed on the body of each half tumbler. The top tumbler is placed at about 27 feet above the water line.

The shoots are made of Siemens-Martin steel, and are provided with wearing plates. They are placed at an angle of 30 degrees, so that the materials may be discharged on both sides of the dredger. A turnover trap for changing the direction of discharging, working from deck, is provided. The shoots are provided with two movable parts, which can be lowered or raised by the two hand winches named above.

Power is transmitted from two pulleys on the engine shaft to two similar pulleys on the upper tumbler shaft through two camelshair belts. The transmission shaft has two cast steel pinions, working on two cast steel bever geared wheels, whereof one is keyed on each side of the upper tumbler. The transmission is so arranged that every minute from 14 to 16 buckets pass the upper tumbler. The advantage of the belt transmission is that it forms a natural friction safety device, which will always do its duty when the buckets are unexpectedly overloaded with large stones, trunks of trees, etc. The main framing is made of steel plates. It is of the tubular form, and so constructed that it can be lowered to deck level. The forelegs are riveted to the sides of the well and are supported by the strengthened floors on the bottom on each side of the well. The afterlegs are supported by a strong girder, also of box form and riveted to the deck. This girder is carried on two legs, riveted to the sides of the hull. On both sides and at the after side, the main framing is sheeted with steel plates. The ladder frame is constructed in an extra strong manner of plates and angles, and on the top it is provided with a small crane of 1 1-2 tons capacity.

The wire rope drum is of cast iron. The ladder has a length of about 88 feet 6 inches, is constructed as lattice girder of steel plates and angles well strengthened by traverse girders and crossbeams. It is provided with rollers of chilled cast iron on steel axles. The axles turn in cast iron bearings protected against mud and sand.

The boat is lighted electrically by means of a direct current dynamo, capable of supplying 1,600 candle power to lamps for lighting deck, engine room, stokehold, etc.

Government Shipbuilding for 1904 and 1905.

The session of Congress recently closed will not be remarkable for its liberality in appropriations for the construction of new vessels for the government, except that it made quite a liberal appropriation for new naval vessels. The following are the detailed amounts appropriated for the fiscal year beginning July 1, 1904, so far as they interest shipbuilders:

For one first-class battleship, to carry the heaviest armor and armament, and to have a displacement of 16,000 tons, at a cost not to exceed $4,400,000, exclusive of armor and armament.

For two first-class armored cruisers, of not more than 14,500 tons displacement, not to cost more than $4,400,000 each, exclusive of armor and armament.

For three scout cruisers, of not more than 3,750 tons trial displacement, to have the highest speed compatible with good cruising qualities and great radius of action, at a cost not to exceed (exclusive of armament) $1,800,000 each.

For two colliers, capable of accompanying the battle fleet, to have a capacity of carrying 5,000 tons of cargo coal, at a trial speed of not less than 16 knots, the sum of $1,250,000 each is appropriated, with the proviso that they shall be built in navy yards, one on the Atlantic and one on the Pacific coast, to be designated by the Secretary of the Navy.

For constructing sub-surface or sub-marine torpedo boats the sum of $850,000 is appropriated, the type or types to be selected by the Secretary of the Navy after a board has given the several types presentd a thorough competitive test.

The total amount appropriated for the naval establishment, to be used for the further increase, will therefore be $21,950,000.

For the other maritime branches of the government the appropriations were very meager. Bills for the construction of a derelict destroyer, several revenue cutters, and a number of light vessels and tenders failed of enactment, although they were all passed by the Senate. The following were authorized in the sundry civil bill.

For the purchase or construction of a boarding tug, for the use of the immigration service in New York harbor, $75,000.

For a lighthouse tender, for the fourth lighthouse district, to replace the *Zizania,* $125,000.

For a lighthouse tender, for the sixth lighthouse district, to replace the *Wistaria,* $130,000.

For a new lighthouse tender for Lake Superior the sum of $400,000 is authorized.

For the expenses of transferring two light vessels for the Pacific coast, now being constructed in New York and New Jersey to San Francisco, the sum of $20,000 is made available.

It is quite probable that one or more of the three new scout cruisers authorized by this congress will be fitted with turbine engines, as the Bureau of Steam Engineering has been working on plans for the same, in anticipation of the passage of the bill.

Lumber Rafts in the Pacific.

With the advance of civilization westward the center of logging interests has also moved to the west. A hundred years ago it was in Maine; fifty years ago it was in the middle west; and twenty-five years ago Wisconsin and Michigan were supplying half the lumber of the country. Recently the forests of the northwest Lake region have become denuded to such an extent that the greatest amount of lumber is now being cut from the states of California, Washington, and Oregon. It is estimated that they contain over eight hundred billion feet of uncut timber. Enormous as this figure is, it is stated that at the present rate of cutting only ninety years will elapse before these forests are exhausted.

A writer of the *World's Work* for February describes and illustrates the modern method of "Lumbering by

THE EMPTY CRADLE FOR BUILDING A GREAT RAFT—ON THE COLUMBIA RIVER, NEAR ASTORIA.

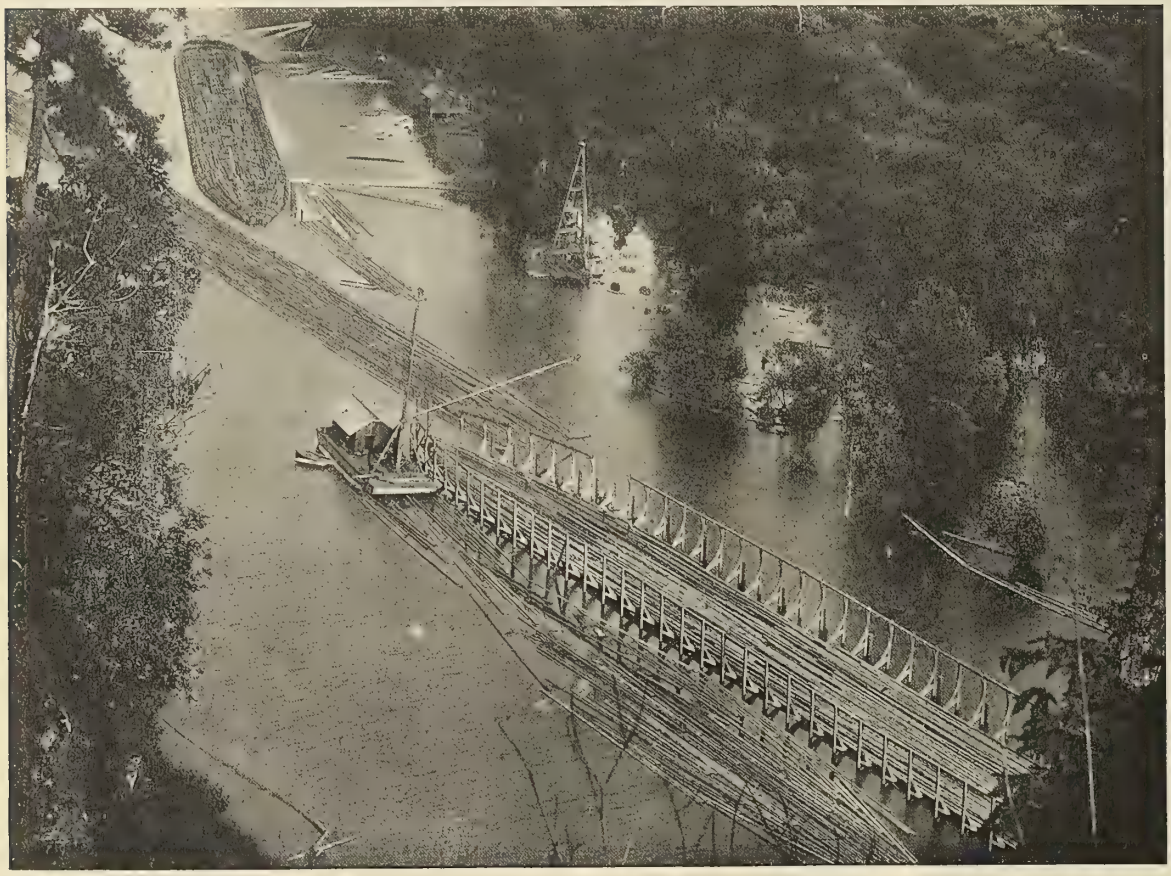
A GIANT RAFT ON THE COLUMBIA RIVER, BOUND FOR SAN FRANCISCO.

[Photographs from World's Work.]

Machinery" in the northwest. The operations in western timber camps are conducted on a gigantic scale; one company alone owns one million acres of heavily-timbered land, employs about 500 men, uses 75 horses, 20 donkey engines, and has built nearly 100 miles of railway. The work of the logging camp is systematized as nicely as that of a factory, and work continues throughout the year, except in specially inclement weather. The trees which are to be cut are marked and the direction in which they are to fall are decided by experienced men. The first cut is made from 6 to 8 feet from the ground with a cross-cut saw handled by two men, termed fellers, who stand on an improvised platform. This cut is made on the side of the fall at right angles to the line of direction and about one-third through the trunk. The undercut is then made with axes, and then the fellers begin sawing from the opposite side. When the cut is made wedges are driven in to guide the fall, and so experienced are the men that a tree may be sent to the ground within a very few inches of the position decided upon.

The next gang of men are called the buckers, who cut the tree into logs. These are followed by the barkers, who remove the bark from the side on which the logs are to be hauled. This is necessary as the bark is stout and rough and hinders the movements of the log. Swampers clear away the underbrush and make a passage for the logs, and the hook tender then takes charge and fastens to the log a heavy chain attached to a cable. This cable, which is from five to three thousand feet long, leads through several open sheaves to a donkey engine which pulls the log to the loading skids alongside the railroad track or to the river bank.

The coast fir trees are especially desirable for masts. The United States Navy Department recommends the use of fir on war vessels for all wood purposes except decorative interiors, and it is stated the flags of Windsor castle and that of the Japanese emperor fly from Oregon fir poles. The masts and spars on the racing yachts for King Edward and Emperor William were shipped from Puget sound. These trees are splendid specimens, perfectly straight, and ofttimes attain a height of 300 feet.



VIEWS ON ONE OF THE TRIBUTARIES OF THE COLUMBIA, SHOWING A FINISHED RAFT, A CRADLE BEING FILLED, AND A RAFT OF LOOSE LOGS TO GO INTO THE CRADLE.

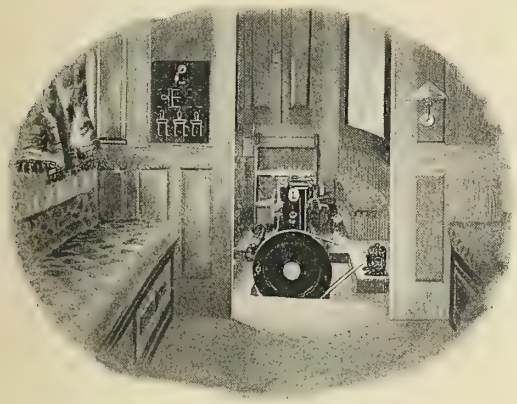
Of late rafting the logs down the coast to San Francisco has become quite general. A cradle, with one side removable, is built as shown on page 259, and floated in the river between rows of pilings. It is then filled with loose logs by means of derricks and the logs are securely bound together with many heavy chains, and in some rafts there is as much as 100 tons of chains used. When the raft is completed one side of the cradle is pulled away and the raft is floated out. It is then ready for the tow boats which tow it to its destination.

Electric-Lighting Outfit for Launches.

BY D. A. RICHARDSON.

For large launches or houseboats undoubtedly the finest electric light outfit is a gasoline or steam driven direct connected set, but for the small and medium sized launch a compact enclosed generator, belted to the flywheel of the engine, is the most practical method of obtaining electric lights. The storage battery will be found an essential of such a plant, storing up as it does when the engine is running electricity enough for several hours of light.

There are three systems of protecting the battery, generators and lighting circuit. The most common is the circuit breaker, but it is used mostly on larger plants and is expensive; the second one is the fuse system, which is simple and easily handled, and adds to the appearance of a small switchboard, while the third system is the automatic switch, which is all right for very small outfits, but is liable to the troubles of all delicate automatic apparatus and is not suitable for large outfits where much current is used.



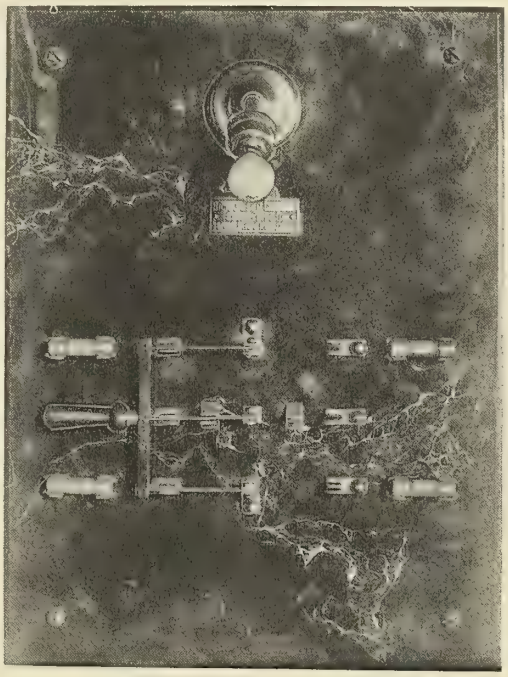
ELECTRIC GENERATOR DRIVEN BY BELT FROM MAIN ENGINE.

SWITCHBOARD.

The switchboard should be simple, easy to understand and to handle, and so far as possible, especially for small outfits where no regulation or meters are used, it should be so arranged that everything is accomplished by the manipulation of one switch. A medium-sized plant should have a switchboard with rheostat, for regulating the voltage, meters for intelligent and successful control and proper circuit and control switches. The control switches should allow the amperes to be read as well as the voltage of the battery, generator and light circuits, at will. In the small outfits the brightness of the pilot light on the switchboard, together with the amount of gassing of the battery, is near enough indication of the full charge. A new cheap indicator is being tested out, and will soon appear on the market for use on small switchboards, which will show at a glance the extent to which the battery is charged. This instrument will answer almost as well as meters, and is much easier for a person not familiar with electricity.

With the fuse system everything is well protected, and the new enclosed arc fuses give absolute protection from explosion, there being no visible flash when the fuse breaks. The fuses should be easily removable, and so arranged as to protect the generator by burning out if the operator forgets to throw over the switch before shutting down his engine. This prevents the battery from burning out the generator. Also the circuit running to the lights should be fused to prevent running the batteries down should a short circuit occur along this line.

The switchboard should also provide for the regulation of the lights so that the lamps are not burned out when charging the batteries. This light regulation should be accomplished with the main switch which puts the batteries on charge, so that the operator has no reason to think of this point or be obliged to look out for it.



SWITCHBOARD SUITABLE FOR SMALL SET.

Every switchboard should be neat in appearance and of slate or marble, that the switches may be well insulated and remain where placed. The switches should be ample for the lights to be carried and of a thoroughly substantial type.

GENERATOR.

The generator should be fully enclosed, or nearly so, and as waterproof as possible, all leads being inside. It should be of ample size for the work, and have rectangular carbon brushes. A cheap generator is the poorest investment for boat work. It should be built for marine work, and with proper insulation for the same. Proper provision should be made for adequate lubrication and ring oiled bearings are preferable for medium-sized outfits.

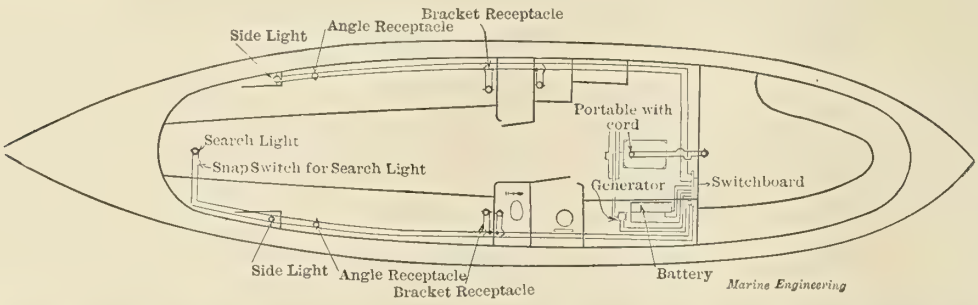
STORAGE BATTERY.

The storage batteries for a successful outfit should be placed in strong jars, preferably of rubber, and assembled in special cases, so that the jars are not crowded and are thoroughly sealed with covers at the tops to prevent leakage of any electrolyte into the bottom of the cases. The plates should fit the rubber jars very carefully, in order to prevent any movement of the plates; at the same time allowance should be made for the swell-

ing of the plates without breaking the jars. The covers should be easily removable for inspection, and should be placed a little below the top of the jar, to prevent any liquid which might get on the top of the cover, from spilling out. The cover should have vented plugs. The plates should be arranged two to each cell, a positive and a negative being connected together, thus facilitating inspection of the plates, for by merley pulling up on the connecting strap the two plates can be looked over and easily and quickly returned. A cheap storage battery is a poor investment.

Strict attention to the above details will add materially to the life of the battery. Little care will be needed in the average use of the storage battery each season other than filling each cell with water to the proper height every two weeks or so. In the winter it would be wise to leave the batteries with some competent electrician to be taken care of and to be delivered in the spring with the electrolyte the right strength, everything cleaned out, and ready for another season, yet by carefully following the directions accompanying each battery it is perfectly possible for any one to dispense with outside assistance. The instructions show how the battery may be emptied in the fall, and remain dry during the winter, being filled up in the spring with electrolyte, and be ready for business as usual. In designing a launch-lighting outfit care should be taken that there are neither too many nor too few cells for the special work required. If too many are used, the number will be an additional burden of caretaking; if too few are used, the fact will be readily seen upon the life of the lamps; therefore the wisdom of purchasing outfits that are put out by a competent engineer or people who have had long experience in the line or work.

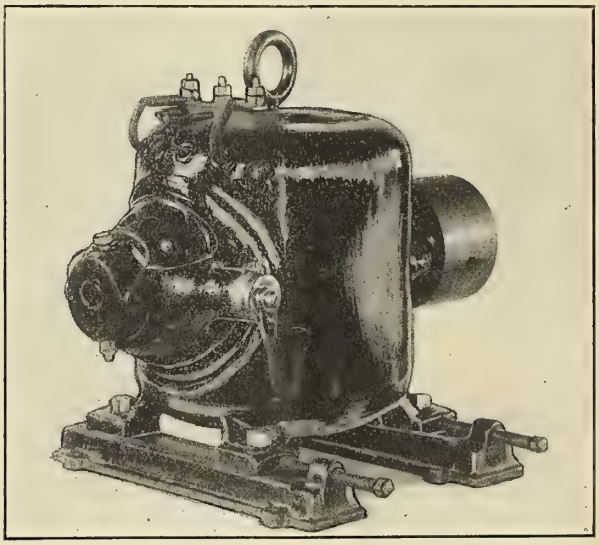
The storage battery is essentially a complete lighting plant, whether on a boat or on the shore. This is proven by the fact that large steam yachts have their own storage battery plants and that a great many town lighting systems have storage battery plants as auxiliaries. It is even more essential to have a storage battery on a small launch than on a yacht, especially where the current used to light the lamps is taken from the flywheel of the engine, as it enables one to have light without running the engine. There is another fact which enters materially into the advantage of storage batteries, namely, the steadiness of the light, even when using the lights while running the engine and charging the batteries. This point will be very noticeable, as the storage battery, properly connected up, will prevent lamps from burning out, and will supply a uniform current with light free from pulsations. The storage battery also furnishes ample current for ignition at all times for starting the engine and for regular running, thus doing away with extra dry cells, magneto and other apparatus. The only disadvantages of the storage battery are their weight, extra space required and the slight attention which they need once a month and at times when the boat is laid up for the winter. A convenient and simple plan for wiring a launch is given below.



WIRING PLAN FOR LIGHTING A LAUNCH, SEARCHLIGHT, RUNNING LIGHTS, CABIN LIGHTS, STORAGE BATTERY, AND BELT-DRIVEN GENERATOR.

SEARCHLIGHTS.

The searchlight, although in many cases not an absolute necessity, is of great advantage on a launch or yacht of any size. The searchlight can be had of various powers. Some are arc lamps and some incandescent lamps. The arc lamp is necessarily from its construction more expensive, and has more mechanism to look out for.



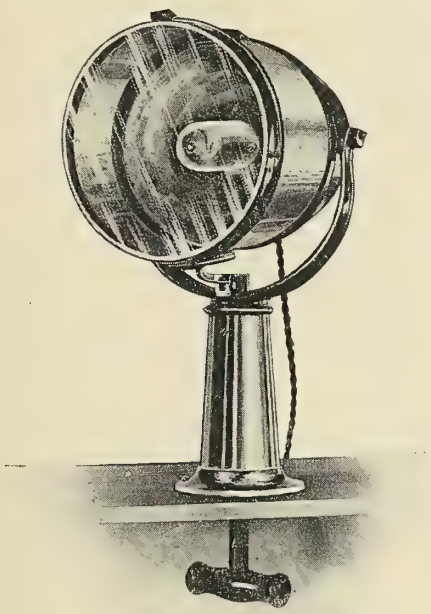
SMALL GENERATOR SUITABLE FOR DRIVING FROM MAIN ENGINE.

A new type of inexpensive incandescent searchlight, here illustrated, has just been put on the market. It is of polished brass, and is for pilot house control. It not

only costs much less than the arc lamp, but it is operated from a few storage batteries which are considered part of the lighting outfit, and is therefore available at all times. It has many advantages over the ascetylene lamp, in that there is no fire required, no carbide to clean out, gives a much steadier, cleaner light and continues the same for hours, and yet does not corrode the reflector. All that is required to light it is to snap a switch, same as with the cabin lamps.

The secret of the success with this incandescent searchlight lies in the special reflector used, coupled with a special searchlight incandescent lamp and peculiar method of placing same in the reflector. The pilot house control is the finest, one handle answering for both horizontal and vertical movements. According to the makers' figures, the range of this incandescent searchlight is over 200 to 500 feet, although much better results than this are being obtained right along.

The arc searchlights are run from the generator direct, and are very much higher candle power, and therefore, of course, longer range, being from 1-3 to 1-2 mile.



SEARCHLIGHT WITH INCANDESCENT LAMP.

The lamps for these outfits should be of best quality, especially for the low-voltage ones, and great care should be taken to see that they are right. There are some new double filament lamps used on complete outfits which give double the life of the old lamps; also a doorknob lamp with the silvered back is now made, which uses about 1-2 the energy with a better light.

The fixtures for the medium size launches should be plain style but substantial, and comprise a portable lamp with socket, side brackets and ceiling lights. The wiring of the boat should be very carefully followed, as it is most important. Because of the moisture, the wire used should be covered with very best quality rubber.

To sum up, a lighting outfit for a launch should have a storage battery, and should be complete in every detail, with a generator of the first quality as a matter of course, switchboard suitable for the size plant used, wire, fixtures, cleats, etc., all of the best design and material.

Finally, a word should be added concerning the cost of small lighting outfits. The simplest one can be bought for about $60. A very practical launch-lighting outfit, consisting of ten double filament lamps, generator, belt, 10 cells storage battery, switchboard with fuses, pilot light, etc., fixtures, wire, cleats, tape, etc., with full directions for installing and operating, can be had for $115, or for $150 including an 8-inch incandescent searchlight. An outfit for a 60-foot launch, consisting of the above but with a more elaborate switchboard, having meters, double the number of storage batteries and lamps and with a 12-inch incandescent searchlight can be had for $270, or with an arc searchlight for $340, or without searchlight, $215.

Trial of S. S. Nikko Maru.

Through the courtesy of the Mitsu Bishi Dockyard and Engine Works, Nagasaki, Japan, the following abstract of the official trial results of the steamship *Nikko Maru*, described in MARINE ENGINEERING of February, 1904, is given below.

The government surveyors and owners' representatives were present at the trial. The machinery ran with smoothness throughout. The boilers steamed well and remained perfectly tight. The ship and engines were completely satisfactory.

Length	420 feet 0 inches
Beam, molded	50 " 0 "
Depth	30 " 0 "
Draft, mean	15 " 6 1-2 ins.
Displacement, mean draft	5,405 tons
Block coefficient	.577
Area of midship section	729 sq. ft.
Midship section, coefficient	.94
ENGINE: Three-cylinder triple.	
Diameter cylinders	31, 51, and 85 ins.
Length of stroke	54 ins.
Working pressure	185 lbs.
PROPELLER: Diameter	17 ft. 9 ins.
Pitch	20 " 6 "
Number of blades	4
BOILERS: Number	2 double end; 2 single end
Diameter	15 ft. 6 ins.
Length	18 ft 0 ins.: 10 ft. 6 ins.
G. S., total	465 sq. ft.
H. S., total	14,840 sq. ft.
Cooling surface condenser	6,414 sq. ft.
Date of trial	December 10, 1903
Weather	fine
Sea	calm
Course	3.458 nautical miles
MEAN OF SIX RUNS OVER COURSE:	
Boiler pressure	185.6 lbs.
H. P. valve chest	172 lbs.
Vacuum	24.7 ins.
Revolutions	98.83
Speed	17.75 knots
Slip	11.23 per cent.
INDICATED HORSE POWER, TOTAL	6,693.8
H. P. cylinder	2,174.9
I. P. "	2,447.6
L. P. "	2,071.3

Electricity in the British Naval and Merchant Marine.

BY SYDNEY F. WALKER.

Electricity is making its way steadily in both His Majesty's naval service and in the much larger sphere of the British merchant marine. In the former service it has been very much handicapped until recently, owing to the peculiar organization of the Lords Commissioners of the Admiralty. As readers of Marine Engineering know, the navy of the United Kingdom is administered by a board consisting of a First Lord, who sits either in the House of Peers or in the Commons, and answers for the navy on all occasions; two Naval Lords, or Sea Lords, as they are usually called, who are naval officers of a certain distinction, but not always of the highest rank (on several Admiralty boards captains have had seats), and two Civil Lords, as they are termed. In addition there is a Secretary to the Navy, who also has a seat in the House of Commons and who answers for the navy where the First Lord happens to be in the Peers and for his chief on all occasions; and a whole staff of officials.

The engineering department is absolutely unrepresented on the board, though an eminent officer connected with that branch has an office at the Admiralty, just as the head of the medical branch has. Electricity is also, or was until within the last few months, unrepresented in any shape or form, either at the Admiralty or in the service at large. The only representative of electrical science carried in even the largest battleships was the torpedo lieutenant, who shared with the fleet engineer the responsibility for the working of all the electrical apparatus on board. Some of the smaller ships carried a torpedo gunner who was an electrical expert and had certain limited authority.

The division of responsibility between the engineering and torpedo staffs resulting from this arrangement was really ridiculous. Electricity has been used in His Majesty's navy for a great many years—twenty at least—for lighting all the large and a good many of the smaller ships, and for some ten years past it has been gradually used for power purposes; yet, until recently, there was no officer actually responsible for the proper working of the apparatus. The engineering staff looked after the engines and dynamos, but their charge ended at the terminals of the dynamos. At these points the torpedo officer took charge, and no alteration could be made in the connections at the switchboard without his permission, and generally without obtaining the key of the switchboard from him. Thus if, as it often happened, the engineer on watch found it necessary to stop one of the engines and dynamos and connect another set, he could not do so, no matter how pressing might be the necessity unless the torpedo officer had given his permission to do so, and had unlocked the switchboard locker.

THE METHOD OF WORKING GENERATING SETS IN H. M. NAVY.

The method of working lighting and power plants in His Majesty's navy has been on what is termed on this side the independent system, in which each engine and dynamo is run separately and takes its share of the load separately, without reference to the others. The method was probably best suited to the conditions all things considered. Where two or more machines are running together, if they are connected in parallel there is always the possibility of a difference of speed or armature resistance between the dynamos, and the result is that that dynamo which is running at the lower voltage cannot deliver current at all to the service, and, in addition, said dynamo forms a path for the current of higher voltage from the other dynamo to flow back and cause serious trouble.

In the early days of electric lighting there were many mysterious accidents due to this cause. Two or more engines and dynamos would be running together in parallel, apparently doing their work all right, when suddenly one of the armatures of a dynamo would burn up. In one case, which came under my notice, and which was put to me as an engineering puzzle, there were three high-speed engines running three dynamos, all connected up in parallel and furnishing current for the lighting service of an exhibition Suddenly one generating set stopped dead, a second reversed, and the third ran for a short time and was then observed to be burning. The explanation was very simple. The set which continued to run was generating a slightly higher pressure at its terminals than either of the other two, consequently the others could not deliver any current; in addition the coils of the other two formed paths for the current of high pressure or voltage. The difference between the voltage of the leading machine and the one that reversed was sufficient to allow enough current to pass through its coils to run it as a motor against its own engine, and the difference between the leading machine and the one which stopped was sufficient to bring it to rest, also against the work done by its own engine.

Usually results were not so marked as this. What generally happened was that each engine and dynamo in turn took the lead and carried all the load for a time until its coils became overheated and its insulation badly strained. This condition only became manifest when the inevitable break down took place, and only then because the matter was investigated by an expert who really understood his work.

With the independent system there was no danger of this. Each generating set was apportioned its own share of the load. When the load was light, with lighting during the day, usually only one set was run, and all the circuits were connected to this machine. When the load came on, say at night, certain circuits were switched on to a second machine which was run up for the purpose; this in turn was followed by a third, and so on, the reverse process being followed when the load decreased again. The only danger with this arrangement was that one machine might be left on, doing all the work, after the load had increased beyond its proper figure.

PARALLEL RUNNING.

It may perhaps be well to explain the difference between parallel and independent running. In parallel running the terminals of each dynamo that is furnishing current are connected to what are termed bus bars, usually large, heavy copper bars fixed on the back of the switchboard. The idea of parallel running is that the bus bars act to a certain extent as reservoirs of electricity. All the current that is generated by all dynamos

is taken to the bus bars and all the distributing circuits are connected also to these buses. The engineer in charge can at any minute disconnect any circuit from the bus bars and by so doing cut off its supply of current, and he can similarly disconnect any dynamo. The great beauty of the arrangement is that it is practically automatic, within certain limits. As all the circuits are connected to the bus bars the lamps or motors connected to any one of these circuits receive current in proportion to the pressure delivered to the feeder cables as they are termed, and this pressure can be regulated at the switchboard.

As the load comes on, say toward evening, there is no violent change in the voltage delivered to the lamps which are burning, even when a good many are turned on together, and the engineer connects more and more dynamos as the load increases. As he knows when this will be, he has the additional machines ready to switch on when required. The operation with continuous-current machines is very simple.

The engineer can also arrange so that each set takes a certain portion of the load at any instant. He has complete control of all apparatus by means of adjustable resistance placed in the exciting current of the field magnets of the dynamos, and by altering the admission of steam at the stop valve of the engine.

ARRANGEMENT FOR SMALL PLANTS.

The arrangement described above is that which rules in a generating station where the quantity of current supplied is large and where the attendants have nothing else to do but look after the machinery. In all large stations, and even in some comparatively small ones, there is some one to watch the volt and ammeters placed on the switchboard, but in a small station, such as that on board a steamer, even where the supply is large enough to warrant the use of two or more engines and dynamos, it would usually be out of the question to have all the elaborate apparatus described above.

The usual plan adopted is on tramps and small steamers to have one engine and one dynamo, and on large steamers to have two or more engines and dynamos of total capacity somewhat in excess of that required, and to divide the load between them by a simple switchboard. The dynamos are generally compound wound in these cases, but it is not usual to arrange for altering the current strength passing through the field coils, or to give the engineer in charge the elaborate control that he has in large generating stations. It would be money thrown away, and would probably lead to more break downs than anything else. However, without complete means of control the engineer can never be sure that one of his dynamos is not doing all the work while the others are merely acting as motors, if the machines are run in parallel.

In a steamer and in other small plants where electricity is used for lighting, the electrical apparatus is only one of many others, and the fuel it consumes is usually only a small fraction of the total consumption, so that there is no special reason to provide apparatus of a highly economical type. When it comes to large plants the question of fuel economy is quite different. Then every detail which tends to save fuel should be considered.

The future of electricity looks more hopeful in the British navy. The Lords Commissioners of the Admiralty have recently made some very bold departures in a direction in which, as usual, America has led the way, *i.e.*, the training and rank of officers of the engineering branch. They have also commenced a thorough system of education in electricity, and have gone so far as to appoint an official at the Admiralty to look after electrical matters.

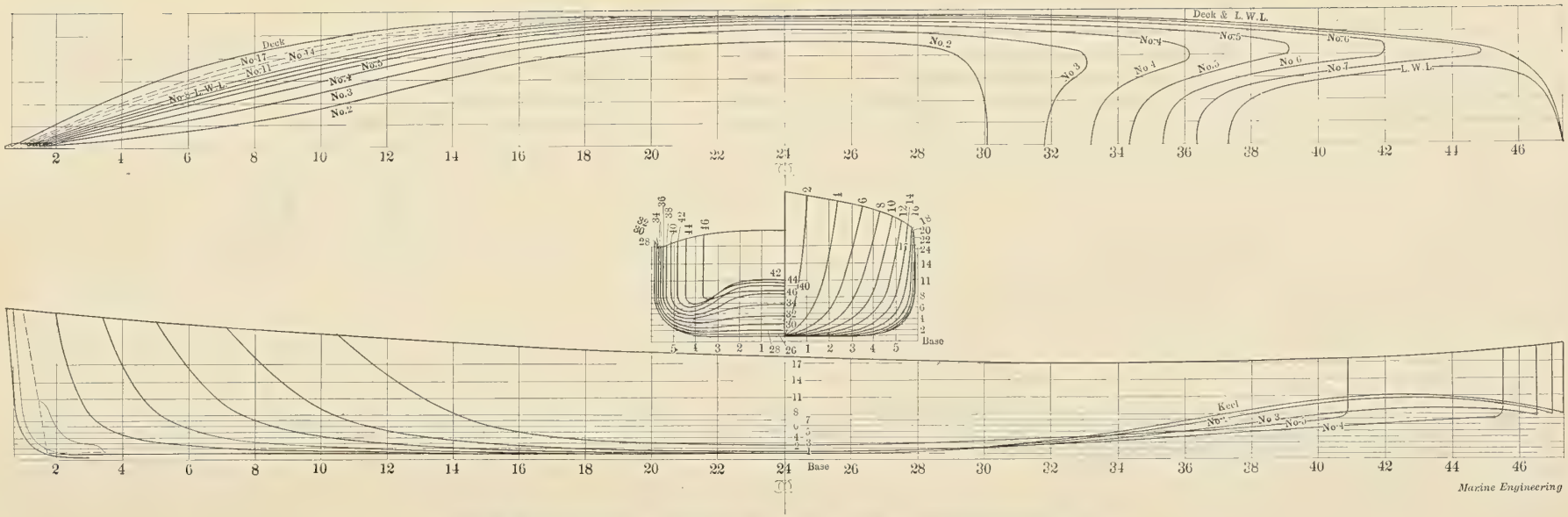
Return of Antartic Expedition.

The Antartic expedition, under Captain Scott, on board the ship *Discovery*, has returned after a successful voyage. Reports from New Zealand state that the expedition found that Wilkes Land was non-existent. Some forms of animal life, consisting mostly of birds, were found, but the only species of vegetable life were morses. Biological evidence indicates that an immense continent once connected the Antarctic land and Australasia. The main practical interest of the expedition lies in the results of the magnetic investigations. Continuous observations were taken in the neighborhood of the magnetic pole.

The ship withstood many severe crushing strains from the ice, and was once blown ashore in a heavy gale. From the *Shipping World* are obtained the following particulars of the *Discovery:*

"The vessel was designed by Mr. W. E. Smith, one of the chief constructors at the Admiralty, and was built by the Dundee Shipbuilders' Company, Ltd., the engines, capable of indicating 450 horse power, having been constructed by Gourley Brothers & Company, Dundee. She is constructed throughout in the strongest possible manner, and is bark rigged, with two decks, with a flat and a short forecastle forward. Accommodation for those on board is provided under the upper deck. The stem is of the ice-breaker type, with strong fortifications. The length of the vessel between perpendiculars is 172 feet; beam, 34 feet; and depth, 19 feet. The timbers are of oak dowelled and bolted together throughout, and the keel, deadwood, stem and stern post are also of oak. The planking is of American elm and pitch pine, and the inside beams are of oak. With the object of avoiding the magnetic influence of iron on the scientific instruments on board, it was decided that for a considerable radius amidships the knees and fastenings should be of naval brass. A heavy wagon-cloth awning of strong woollen felt was provided for 'winter wear.' The fittings and equipment of the vessel are of the most modern type."

Lloyd's Register of Shipbuilding Returns.—For the quarter ended March 31, 1904, returns filed by Lloyd's state that, excluding war ships, there were 398 vessels of 988,644 gross tons under construction in the United Kingdom. Compared with the tonnage of the previous quarter there is an increase of 90,000 tons, but with the total reached in September, 1901, which is the highest on record, the present figures show a decrease of 425,000 tons. Dividing the tonnage into districts gives Belfast the lead with 193,633 gross tons, closely followed by Glasgow and Newcastle.



LINES OF SHALLOW-DRAFT, TWIN-SCREW TUG BOAT USED ON THE SASKATCHEWAN RIVER.

Shallow-Draft, Twin-Screw Tug Boat for the Northwest.

An interesting boat, for an unusual service, has recently been designed by Mr. Morris M. Whitaker, of Toronto, for Captain Deacon, of Prince Albert, N. W. T. The boat is intended for use in towing logs on the Saskatchewan river. The peculiarity of this river is that the sand bars are constantly shifting, and where today there may be six feet of water, to-morrow there may be only six inches. The bottom of the river, however, is soft, so that in the boat here illustrated, no dead wood was provided to protect the propellers or rudder.

The hull is being put together at Prince Albert, and is built throughout of hackmatack, which in Canada is termed tamarac, and practically all the frames are cut from natural crooks. In order to navigate the shallow waters, the twin screws are placed in a tunnel aft, so that the tips of the blades are the same draft as the keel forwards. The principal dimensions of the hull are: length, 70 feet; beam, 12 feet; draft, 21 inches; depth amidships, 4 feet 6 inches.

The keel is 9 by 10 inches, as will also be the keelson, but increases in dimension under the engine and boiler. The frames are 5 by 3 inches at the heel and 4 by 3 inches at the head, spaced 18 inches. The planking is 2 inches up to the water line and 1 1-2 inches above, except in the tunnel for the screws where it is reduced to 1 1-4 inches. The clamps are 9 by 10 inches, deck beams 2 by 6 inches, rubbing strake, or wale, 4 by 5 inches; all these tapered at the end. The deck is of 1 1-2- by 4-inch planking.

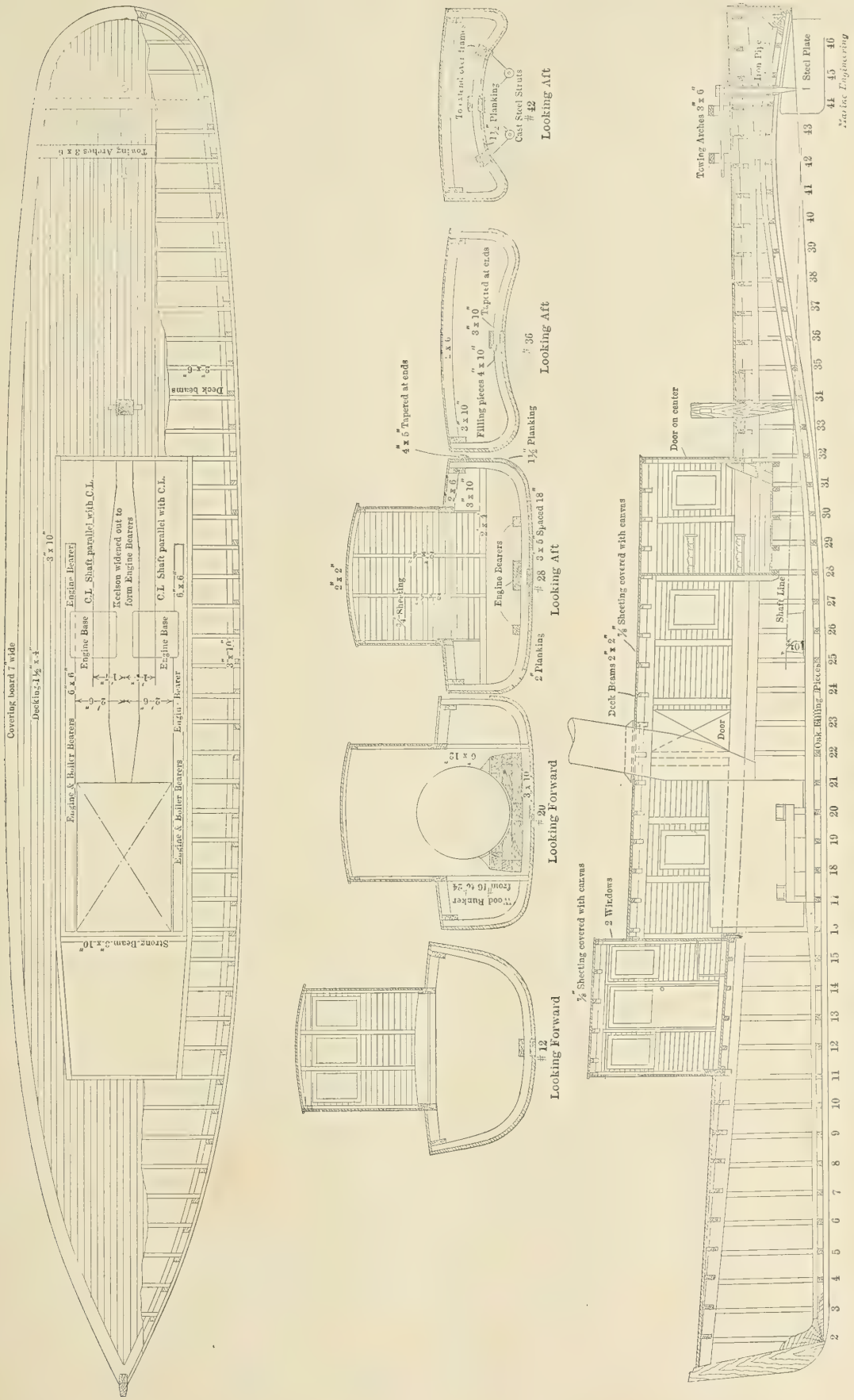
The deck house is very simply constructed of 2- by 4-inch stiffeners with 3-4-inch sheeting tongued and grooved. This is made as simply as possible, for there are very few facilities for doing fancy work at Prince Albert. A small cabin is placed aft of the engine room with two berths.

As wood fuel is plentiful, and can be picked up anywhere along the river, there is only provision in the wood bunkers on each side of the boiler for carrying a cord of wood. The rudder is a steel plate with a steel stock.

The machinery, built by the A. R. Williams Machinery Company, of Toronto, consists of one Scotch return tubular boiler 5-feet diameter by 5 feet 6 inches long designed to carry 125 pounds of steam. On each shaft will be mounted one single high-pressure engine 6 by 8 inches, driving 30-inch propellers, right and left hand.

Throughout, the design of engine and hull have been for a boat to be used in the roughest service far away from repair shop, that could be run constantly with small possibility of breaking down.

Saving From the Use of Oil Fuel.—In the annual report of the president of the Oceanic Steamship Company, it was stated that largely through the adoption of fuel oil on the steamer *Mariposa,* engaged in the Tahiti service, the profit of the last year was $38,309, as against a loss of $19,275 for the previous year. Also, in the direct Honolulu service, on which the steamship *Alameda* runs, a saving of $53,000 resulted from the equipping of this steamer with oil burners. Sixteen voyages were made during the last year.



CONSTRUCTION DRAWING OF THE TUG TO BE USED ON THE SASKATCHEWAN RIVER, DESIGNED BY MORRIS M. WHITTAKER.

STEAM TURBINE PROPULSION FOR MARINE PURPOSES.*

BY PROFESSOR A. RATEAU, OF PARIS.

There is no need, in a country which has given birth to the Parsons turbine, to insist upon the interest attached to the application of the steam turbine to the propulsion of ships. The remarkable results which the distinguished inventor of that engine has obtained are matters of common knowledge, and the author is one of those who have most admired and appreciated the methodical manner in which these results have been achieved. Mr. Parsons has himself set them forth in the paper which he read before the Institution at the last summer meeting.

This important question has also attracted much attention in France for several years past, and I propose, therefore, to give the results which have been so far attained there. If these results are but slender, it is due to the fact that the means at our disposal have not been sufficient to enable more progress to be made.

There are, at the present time, two ships fitted with our turbines, namely, the French torpedo boat No. 243, and a first class torpedo boat built by Messrs. Yarrow & Company. The latter alone has been constructed according to our ideas, as the restrictions imposed by the naval authorities upon the French torpedo boat, and the conditions laid down for its propellers have created such difficulties that it has been impossible up to now to obtain a satisfactory speed with this vessel. It was, however, only a trial boat, and the speed was not required to exceed 20 knots; in point of fact, we have obtained over 21 knots. With Messrs. Yarrow & Company's boat, on the other hand, the conditions are such as to utilize the full value of the turbines, and the latter have been further supplemented by a small reciprocating engine for economical working at reduced speeds. The trials with this boat are, therefore, of considerable practical interest, and I have much pleasure in acknowledging our debt to Mr. Yarrow for the breadth of view which he has shown in dealing with these new conditions.

Another small vessel, the *Libellule,* was to have been fitted with a turbine of our manufacture, and the engine has been completed for some time past, but the trials have not yet taken place, as the special boiler with which it was desired to make the experiments was not ready.

Before going into the details of each of these applications of our system of turbine it may be well to set forth some of the obstacles which arise in using turbines for the propulsion of vessels, obstacles which, in the author's opinion, can only be satisfactorily overcome by a joint use of reciprocating engines and steam turbines.

As to the advantages of turbines, these are well known: absence of vibration, great reduction of weight, ease in handling, absence of wear and tear, etc. There is no need further to insist upon them.

The three principal difficulties in applying turbines to the propulsion of ships are as follows:—

(1) Design and arrangement of propellers for a high speed of rotation.

(2) Efficiency of turbines at low speeds.

(3) Reversing and manœuvring powers.

(1) Arrangement of Propellers for a High Speed of Rotation.

When the turbines are not restricted to any particular speed of rotation, a very high efficiency can be obtained, certainly higher than that of the best reciprocating engines.

The author's experiments confirm this fact, which had already been shown by the published trials of the Parsons turbine. Unfortunately, the best speed for turbines is usually much too great for screw propellers. In high-speed vessels, by some give and take between engine and propeller, a working arrangement can be arrived at; but it is not easy to do. The gearing of the rings has to be higher than with a turbine for other purposes, and the turbine itself must be divided up into several sections in series; and, further, it is necessary to devise some arrangement for the propellers by grouping them either singly, in pairs, or in threes on several shafts, and to so increase their surfaces that the extreme outside diameter shall be greater than the pitch, all of which tends to reduce the total efficiency of the engine and propellers.

If, therefore, the turbine is theoretically superior to the reciprocating engine as regards consumption of steam at full speed, it is not by any means certain, *à priori,* that the joint efficiency of both engine and propeller is better, or even as good.

The practical difficulties, moreover, increase as the speed diminishes, for in the first place the total surface (and consequently the size of the propellers) is mainly determined by the principal cross section of the ship, whereas, on the other hand, the size of the turbines is limited only by the speed of rotation, and not by the power developed. The speed of the turbine must be reduced in proportion to the speed of the ship, so that the dimensions of the former are increased, either by the number or the diameter of the moving rings, whilst the power diminishes approximately as the inverse of the cube of the speed. There is, therefore, a lower limit of speed, below which the use of turbines cannot be recommended. The author has already expressed the opinion (in a paper read before the Association Technique Maritime in 1902) that this limit is in the neighborhood of 20 knots. The author is aware that certain ships now under construction for transatlantic service, and of a proposed speed of 17 knots, are being fitted with turbine engines, but the future will show how these will turn out.

(2) Efficiency at Low Speed.

If the steam turbine is capable of giving good results at the maximum power, it cannot be gainsaid that the results are certainly unsatisfactory at reduced speeds, not so much on account of the reduction of power as on account of the reduction in the speed of rotation, which involves a lowering of what is termed the "hydraulic efficiency" of the turbine. The curves in Fig. 2 show the general behavior of the steam consumption per horse power of a turbine, compared to that of a reciprocating engine, in terms of the speed of the ship, assuming that this consumption is about the same in

*Read at the spring meeting of the forty-fifth session of the Institution of Naval Architects, March 25, 1904.

both cases at the maximum speed. In these approximate curves, it will be seen that at reduced speed the consumption of steam per horse power for the turbine is much higher than for the reciprocating engine. This drawback does not signify in the case of merchant vessels that keep at about their maximum speed. On the other hand, it becomes a serious one for warships that are rarely working at full power. The increase in the coal consumption at speeds of, say, 12 to 15 knots, at which they are usually working, would, however, greatly diminish their radius of action. A partial remedy, as used by Mr. Parsons, may be effected by adding a supplementary turbine for cruising purposes, into which the steam first enters when proceeding at low speeds. This, however, does not improve the hydraulic efficiency of the turbine, and the steam consumption nevertheless remains high.

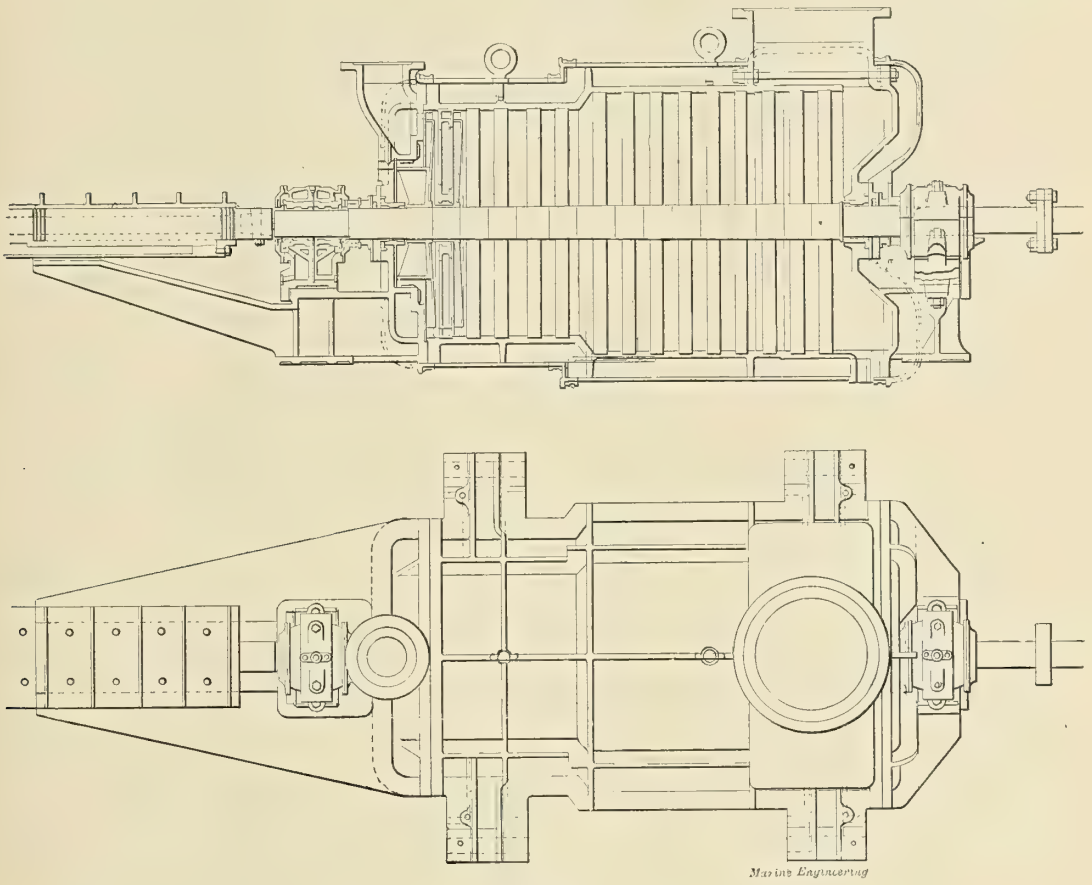


FIG. 1.

The author considers that under no circumstances can turbines alone be economically worked at low speeds, and that the only satisfactory solution is the employment of a reciprocating engine of more or less power, according to the circumstances, in conjunction with turbines. With this combination economical results can be obtained at all speeds, and an example of this will be given later.

(3) Reversing and Manœuvring Powers.

With a reciprocating engine stopping and reversing are effected in the simplest possible manner, whereas the very principle of the turbines is essentially opposed to this. Various inventors have tried to solve this problem by means of special blades to enable the same rings to be used for both directions of motion, but these attempts do not appear likely to come to anything, as one can only obtain reversibility by a considerable sacrifice of efficiency in forward motion. It is, therefore, necessary to supplement the turbine by special engines for going astern, and, as it is obviously impossible to have the latter as powerful as the former, one must be satisfied with a very much lower speed astern than ahead. This difficulty in freely going astern makes manœuvring very awkward. The engine for going astern may be a reciprocating one, which would also be of use for going ahead, but it can just as well be a steam turbine. From the very start, Mr. Parsons used in his vessels special turbines for going astern, and these were attached to the same shafts as the main turbines, but this arrangement has the inconvenience of taking up a good deal of space lengthways.

In my patent of 1898 I have indicated how these can be fitted so as to be, as it were, hidden inside the main turbines on the low-pressure side, and without taking up any additional space. When they revolve freely, the astern rings offer no appreciable resistance while the main turbine is at work, and, conversely, the latter is idle when the astern turbine is in motion. This is the arrangement we have got in torpedo boat No. 243 and in the *Libellule*, and it has the advantage of great sim-

plicity. I think that Mr. Parsons has also made use of a similar arrangement in a certain number of his recent vessels.

According as the astern turbine is more or less developed, so the astern speed is more or less increased. With a single live ring, as on torpedo boat No. 243, and for the same expenditure of steam, the stern speed will be about 40 per cent. of the speed ahead, but with two rings it can be increased to 50 per cent. Adding more rings, however, adds very little to the speed, unless the number is so greatly increased as to make this engine almost as important as the principal one.

For quickly stopping a vessel turbines are apt to be inconvenient. After steam is cut off, the propellers continue to revolve by the action of the water, and they usually carry around with them the live rings, for the resistance to rotation is very slight. One can, however, increase this resistance by admitting steam in the opposite direction on the astern rings.

This question of stopping, reversing, and manœuvring is one which, in the author's opinion, may prove a serious hindrance to the extensive use of turbines for ship propulsion. It is particularly important for warships to be able to manœuver with ease, and it will necessarily lead to the adoption of a combined system of turbines and reciprocating engines.

Combined Use of Turbines and Reciprocating Engines.

For the various reasons given above, the best solution appears therefore to be the simultaneous employment of a reciprocating engine and turbines attached to independent shafts, in order that the reciprocating engine may be used at any speed. Each kind of engine is thus adapted to the work which suits it best. The reciprocating engine does for slow speeds, while the turbines come into play progressively as the higher speeds up to the maximum are required. They can, moreover, be equally well arranged for going astern, and the combination of the two then makes manœuvring almost as easy as with ordinary twin screws. An effective horse power astern of 75 per cent., or more, of that when going ahead can thus be obtained.

The power of the reciprocating engine should not be less than one-sixth of the total, and it can quite well be increased to one-third or even to one-half of the maximum horse power. It may be urged that this arrangement is complicated, and that if such an important reciprocating engine is to be retained, it is better to stick to the present system. In reply to this objection, however, the following advantages may be shown:—

(1) Reduction of weight, although rather more space is taken up in plan.

(2) Easier working and maintenance, and subsequent saving in *personnel.*

(3) Reduction of the vibration due to the reciprocating engines.

(4) Increased efficiency, as the turbine is particularly suited to utilize the expansion of steam up to its extreme limit. It may be estimated that the increase in power for the same consumption of steam would amount to 15 to 20 per cent., or, in other words, that 5 or 6 per cent. increase of speed would be obtained by the arrangement here proposed.

Moreover, this arrangement will make it possible to bring the turbines advantageously into play at a lower limit of speed. With turbines alone, this limit is about 20 knots, whereas, with the combined system, it is possible to begin at 15 knots, or perhaps even less.

Mr. Parsons, in a paper read before the Institution of Shipbuilders and Engineers in Scotland, on "The Marine Steam Turbine and its Application to Fast Vessels," spoke of the speed of rotation of turbines falling when at reduced speed within the limits of those at which reciprocating engines can work, and he proposed to attach the latter on the same shafts as the main turbines, and have both work side by side. At reduced speeds these triple-expansion reciprocating engines would receive steam straight from the boilers, and expand it to, say, atmospheric pressure. The steam would then pass into the high-pressure turbine, and thence into the low-pressure turbine before reaching the condenser. When the power and speed are such that the speed of rotation rises above the limit for reciprocating engines, the steam will be cut off from the latter, and the turbines alone will propel the ship. With this arrangement the reciprocating engines would therefore be useless at the very time when the greatest power is required, and there would, further, be a chance that the engineers might not throw the engines out of gear at the right time, and so cause an accident. This direct coupling of engines, essentially adapted for very different speeds of rotation, is obviously unsound. The only rational arrangement, in the author's opinion, is to make the reciprocating engine mechanically independent of the turbine, by having it act on a shaft and propeller of its own. But, as regards the supply of steam, this can be combined in various ways with that of the turbine, either side by side, as in Messrs. Yarrow's boat, or in series, by having the steam begin on the reciprocating engine and complete its expansion in the turbines. A special combination of this kind, quite different to those already suggested by Mr. Parsons, is what the author advocates.

Results Obtained with the Rateau Turbine.

Description of the Engine.—The author's design of turbine has already been described in several publications. It need only be stated that it consists of a series of flat moving rings, varying in number according to the requirements, and fitted on a single shaft. These rings are placed between circular discs whose rims fit into grooves on the inside of the casing. The shaft traverses these diaphragms through bushes, which allow but little play. Elsewhere, the clearance between the moving and the fixed parts generally exceeds 3 mm., and can even be as much as 5 or 6 mm., without causing trouble. With this arrangement, and by using the work by "impulse" instead of work by "reaction," we have sought to obtain an engine using as little steam as possible, simple in construction, needing but little care in working, and capable of running for a long time with but little wear and tear, which, although inevitable, can yet be reduced to a very small amount. The loss of steam is entirely confined to the clearance allowed around the shaft. Moreover, the live rings are so constructed as to be very light, and this is of advantage

in reducing the gyroscopic effect which comes into play when the vessel pitches.

Fig. 1 shows a longitudinal section and plan of the Rateau turbine. It is taken from the one installed on Messrs. Yarrow's boat. The figure only shows two rings and one diaphragm, as all the others are similar. In this turbine there are 15 moving rings.

It has been said that with this system, supposing one could reduce the loss of steam to a minimum, it would, on the other hand, greatly decrease the efficiency by the friction between the rings and the steam contained in the chambers in which the rings rotate.

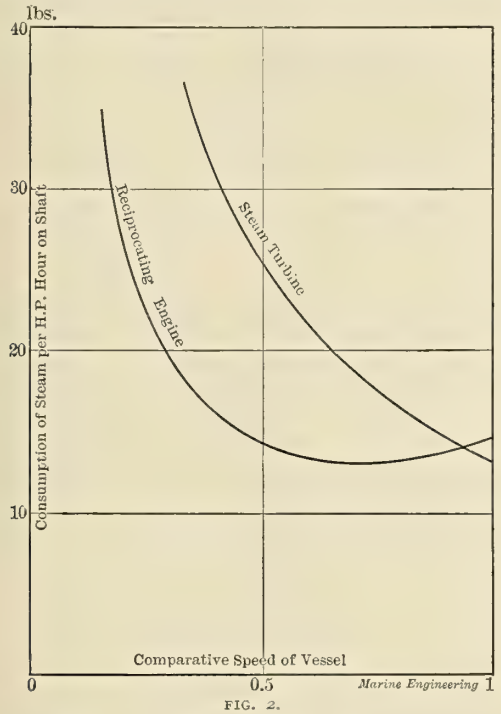


FIG. 2.

As a matter of fact, however, the friction in our engines of 1,000 to 2,000 horse power amounts to only 2 or 3 per cent. of the maximum power—an insignificant proportion—whereas in turbines without diaphragms the loss by the escape of steam reaches 10, 15, and even 20 per cent. of the maximum horse power directly the clearances increase at all. All the trial results so far obtained show that our system of turbine is extremely economical in steam consumption. Here are a few of the principal results obtained:

Turbines of the Torpedo Boat No. 243.—These were the first multicellular turbines which have been constructed from our designs by Messrs. Sautter-Harlé & Company, in Paris. These turbines were designed some five years ago, and several improvemnets have been since effected which considerably diminish the consumption of steam.

A turbine exactly similar to the one installed in torpedo boat No. 243 was tried under the direction of the French Admiralty engineers in the workshops of Messrs. Sautter-Harlé & Company. This engine was coupled to a three-phase alternator, so as to measure exactly the effective horse power of the turbine. The electric current generated was taken up by liquid resistance. As the losses of energy in the alternator had been measured, it was possible to calculate the net effective horse power of the turbine, and consequently its efficiency. By the "efficiency" of the turbine is meant the ratio of the effective power which it develops on the shaft to that which the steam consumed is capable of giving, assuming that there is no loss between the pressure at admission and the pressure at exhaust into the condenser. This experiment gave a result higher by 1 per cent. than had been originally estimated, viz., 54 per cent. instead of 53 per cent., and the results are shown in Fig. 3. The curves there drawn are obtained by reducing the speed of rotation to the uniform speed of 1,700 revolutions per minute, and the condenser vaccuum to 26 inches of mercury. It will be seen that at full power, with a steam pressure at admission to the turbine of 145 pounds per square inch, the consumption per effective horse power on the shaft is 15.2 pounds. At the normal speed of 1,800 revolutions per minute, for which the engine was designed, the efficiency is rather higher, and the steam consumption rather lower.

We can now make engines of this power with 60 per cent., or even 70 per cent., efficiency, according to the speed of rotation, which can be used for the turbines, depending on the use for which they are designed.

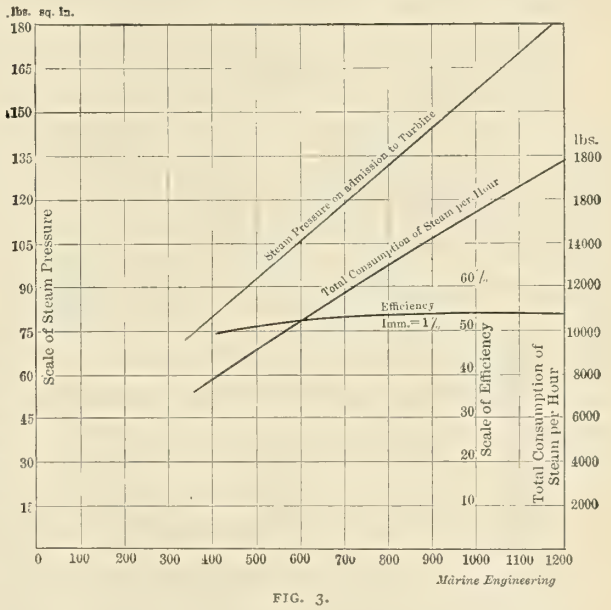


FIG. 3.

The turbine for the Yarrow boat has not yet been tested at the works up to its full speed, but from previous calculations it is estimated that the efficiency should be 61 per cent. at a maximum of 2,000 horse power, with a normal speed of 1,500 to 1,600 revolutions per minute. The loss due to friction between the rings and the steam is only 41 horse power, or 2 per cent. With 170 pounds per square inch pressure, and a vacuum of 27 inches, the consumption of steam of this engine is $\frac{8.2}{0.61} = 13.4$ pounds per effective horse-power hour, which corresponds to 11.7 pounds per indicated horse power for a reciprocating engine having 12 per cent. loss due to internal friction.

Other turbines driving alternators, continuous-current dynamos, centrifugal pumps or fans, and constructed by Messrs. Sautter-Harlé, have been carefully tested, and among the results obtained I would call attention to the following:—

An engine of 600 horse power, at 2,400 revolutions per minute, consumes 14.6 pounds per electrical horse power per hour. The efficiency of the dynamo being 91 per cent., it follows that the consumption of steam for the turbine was 13.3 pounds per effective horse-power hour, or 11.3 pounds per indicated horse-power hour, assuming the efficiency of the reciprocating engine to be 85 per cent., the steam pressure at admission being 142 pounds and the condenser vacuum 26 inches.

An engine of 350 horse power driving an alternator at 3,000 revolutions per minute showed a consumption of 26.2 pounds per kilowatt generated by the alternator (including exciter), the steam pressure at admission being 152 pounds, and the condenser vacuum only 24 inches. The efficiency of the alternator being 87 per cent., this corresponds to a steam consumption of 14.1 pounds per indicated horse-power hour. It will be seen that this was a case of a relatively weak engine working with a very poor condenser vacuum.

A low-pressure turbine of 350 horse power, installed in a mine at Bruay, gave an efficiency rather higher than the above, the total efficiency of the turbine and dynamo combined reaching 58 per cent., or for the turbine alone 63 per cent. Recent tests have shown that the efficiency of this engine has remained the same after a year and a half of continuous work, and no appreciable increase in total steam consumption for the same amount of energy produced has been observed.

A turbine pump of 500 horse power, for raising 950 gallons per minute to a height of over 1,200 feet, and which was recently tested, gave a consumption of 22.5 pounds per horse-power hour in actual water raised, the pressure at admission being 90 pounds per square inch, and the condenser vacuum 26 inches. The efficiency of the pump being 70 per cent., this corresponds to an efficiency of 61 per cent. for the turbine. In all the above cases the steam was not superheated.

It will be seen from these examples that even for engines of only 300 to 600 horse power a working efficiency of over 60 per cent. can be obtained, while for engines of 1,000 horse power and over it is certain that upwards of 65 per cent. efficiency can be realized, as already stated. Hence it is easy to arrive at the consumption of steam per E.H.P. under various circumstances, by using the formula which I have already given. For instance, we could guarantee that for an engine of 5,000 to 6,000 horse power, supplied with steam at 150 pounds, and superheated to 350 degrees Centigrade, with 28-inch vacuum, the consumption per E.H.P. would not exceed 9.6 pounds, which corresponds to 8.6 per horse-power hour, assuming 10 per cent. to be lost in internal friction.

In order to properly understand the value of these figures, it is necessary to compare them with those obtained with reciprocated engines. When the expansion of steam in the cylinder has been carried sufficiently far, which occurs at from one-half to two-thirds of full power, the efficiency of powerful reciprocating triple-expansion engines is as much as 62 per cent. (this is net efficiency—that is to say, the ratio between the work performed on the shaft and the work that the same amount of steam would give with no loss). But this is not the case when the engines are working at full power, for then, in order not to increase the weights too much, especially on warships, one must increase the admission to the cylinder up to and even beyond 70 per cent. From an investigation made by Mr. Lelong, a French Admiralty engineer, published in the "Transactions of the Association Technique Maritime" (1899), the efficiency in work delivered on the pistons of several engines of from 3,600 to 8,400 horse power, varies from 51.7 per cent. to 57.8 per cent., or an average of 55.2 per cent. (Carnot, Charles-Martel, du Chayla, Galilée, Lavoisier). Deducting therefrom 8 per cent. for internal friction losses, this would leave 51 per cent. for the net efficiency, whereas, from what has been said above, steam turbines can easily yield over 60 per cent. net efficiency when working at full power.

I will now give a few details of the application of these turbines to ship propulsion.*

Torpedo Boat No. 243.

Five years ago, in 1898, the French Admiralty began to experiment with steam turbines for the propulsion of warships. Knowing that we had already given attention to this question, the Admiralty invited Messrs. Sautter-Harlé and the author to supply engines of this kind for a torpedo boat of ninety-two tons. The object of the experiment was also to investigate the working of combinations of propellers. In order to reduce expenses, it was laid down that the hull of an ordinary torpedo boat should be used, and that the turbine should be installed in the space usually occupied by the reciprocating engines, in order to allow the latter to be replaced in position, if necessary, at the end of the experiment. This arrangement caused a great deal of inconvenience in the installation of the turbines and propellers, and it ultimately resulted in the trial not being so conclusive as it should have been. It was naturally very difficult to adapt turbines to a hull designed for a reciprocating engine, as the cross section of the boat has a distinctively V-shaped outline in its lower part, whereas, for the turbines, which have to be arranged one on each side of the centre line, the cross section should have been much flatter on the floor. Hence the impossibility of sufficiently lowering the main shafts where they enter the turbines, which involved their being very steeply inclined, viz., 11 per cent. off the horizontal. Each shaft carried three propellers, and was supported at two points by long brackets fixed to the hull.

These conditions were very unfavorable, the steep inclination of the shafts operating against the efficiency of the propeller, and this was fully brought out in the trials, while the excessive length of the brackets aft considerably increased the total resistance of the vessel. As regards the turbines themselves, they have given very satisfactory results, as shown in the reports of the

*There are, at the present time, either in use or in process of construction, over fifty turbines of the Rateau design, with an aggregate of 25,000 H. P., of which 6,200 H. P. are used for ship propulsion, 950 H. P. for turbine pumps, and 760 H. P. for turbine fans.

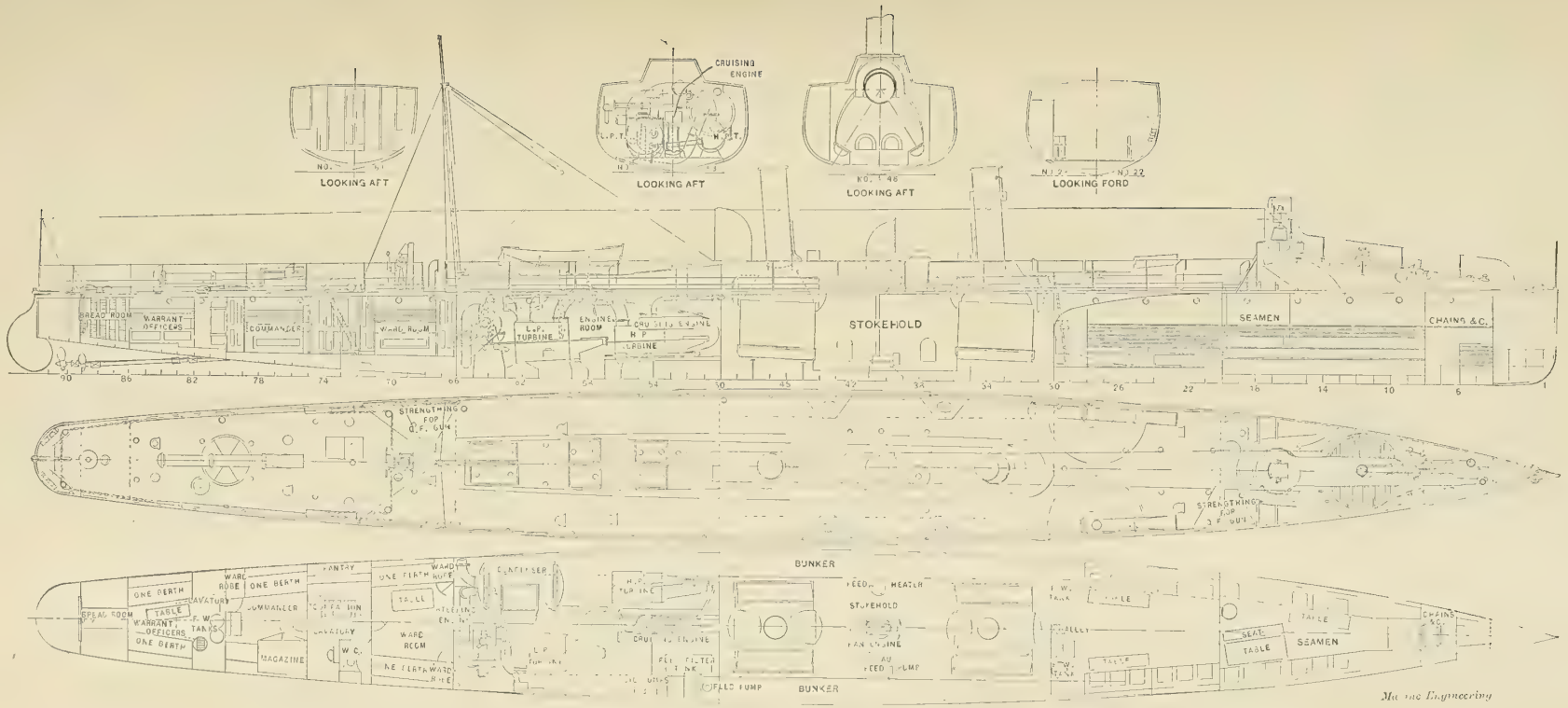


FIG. 4.—GENERAL ARRANGEMENT OF FIRST-CLASS TORPEDO BOAT, FITTED WITH TWO TURBINES AND ONE RECIPROCATING ENGINE.

trials. The two turbines, of 900 horse power (nominal) each, are quite independent of one another. On the exhaust side they enclose a single moving ring for going astern, and in this first attempt we voluntarily sacrificed power in going astern. The chief object, as has been stated, was to see if the combination of turbines and small propellers could give the vessel anything like the speed she would have obtained with reciprocating engines. In point of fact, 21 knots only was the speed obtained, whereas it should have been 24 knots, as the turbines themselves gave rather more power than had been estimated, and this difference is principally attributable, as already stated, to the steep sloping of the propeller shafts.

At the first trials we had some trouble with oil getting into the condenser. This arose from having designed a joint of oil under pressure at the point where the shaft enters the turbine on the low-pressure side. This joint effectually prevented the ingress of the air, but caused a considerable flow of oil to the condenser. To remedy this we put the low-pressure bearing completely outside the turbine and used a novel system of stuffing. As to the other bearings, one at the middle of the shaft and the other at the high-pressure end, they both remained inside the turbine. Lubrication was effected by pumping in oil from the outside, and the excess oil afterwards collected.

After the alteration in the low-pressure bearing, the engines worked very satisfactorily, and although each turbine now has two internal bearings, the leakage of oil to the condenser is very slight, and compares favorably in this respect with a reciprocating engine. Since July, 1902, there have been a large number of trials with this boat in the presence of French Admiralty engineers, and no less than six different arrangements of propellers, distributed in pairs or by threes on each shaft, have been tried. The speeds obtained have varied greatly according to the arrangement of the propellers, but at full power the highest speed varies from 18 to 21 knots, corresponding to a variation of efficiency of 40 per cent. The full details of these trials cannot be given here. I will, however, give the results of

two trials made with propellers of 23.6 inches pitch and 20.9 inches diameter in one case, and 19.7 inches pitch and 23.6 inches diameter in the other. The first trials are summarized in Table A.

Boat Built by Messrs. Yarrow & Company.

Fig. 4 represents the vessel of Messrs. Yarrow & Company, on which the author's system of turbines has been installed. She is a sister ship to the *Tarantula*, which, as is well known, was fitted with a Parsons turbine, and is similar, apart from the system of propulsion, to the first-class torpedo boats of the British Navy.

Displacement	140 tons.
Length	152 ft. 6 in.
Breadth	15 ft. 3 in.

The boilers, of the well-known Yarrow type, are the same as are usually fitted on first class torpedo boats, and are capable of giving a maximum speed of from 26 to 27 knots with ordinary reciprocating engines.

The boat here described was fitted with three propeller shafts, actuated simultaneously and separately by turbines and a reciprocating engine; the latter (of 250 H.P.) works the central shaft, and is quite independent of the turbines, receiving steam directly from the boilers, and exhausting directly into the condenser. This central shaft only carries one propeller, which is 4 feet in diameter.

The side shafts, which are arranged to carry either one or two propellers each, are worked by a turbine in two sections, arranged in series, and rotating in opposite directions. Fig. 1 shows the longitudinal section of the high-pressure turbine. It will be seen that the supports for the thrust bearings have been increased in order to take the full thrust of the propellers. This thrust, being nearly balanced by that of the steam on the drum inside the turbine, it would have been quite possible to reduce the bearings by one-fifth.

The combination of reciprocating engine and turbine as adopted by Mr. Yarrow had already been advocated by Mr. Nabor Soliani, director of the Ansaldo Works, Genoa (see *Engineering*, March 28, 1902). But this is not the only possible arrangement, and an even better one, in the author's opinion, is, instead of letting the reciprocating engine exhaust directly into the condenser, to lead the exhaust steam into the low-pressure turbine, or even, under certain circumstances, into the high-pressure turbine. The author had previously arrived at this conclusion as being the only rational arrangement for economical working at slow speeds.

The turbines were built at the Oerlikon Works in Switzerland.

The total weight of the turbines, which are capable of giving upwards of 2,000 horse power, is 17,200 pounds, or 8.6 pounds per horse power, and this could be reduced by diminishing the thickness of the turbine casings, which have been made unnecessarily heavy, and by suppressing the supports of the thrust blocks.

At the point where the shafts pass through the ends of the casing, water-tightness is obtained by the same system of packing that is employed with land turbines. A special regulator governs the pressure on the four glands so as to prevent any access of air. With this arrangement it is easy to obtain a good vacuum in the condenser, and one of the two air pumps originally installed has consequently been suppressed. As will be seen in the following table, the vacuum has, with a single air pump, been kept constant at 27 inches at all powers.

Several trials have been made with this boat from October 13, 1903, up to quite recently, and the author was present at some of these trials, which were under the immediate supervision of Mr. Marriner, chief engineer to Messrs. Yarrow & Company.

First Trials.—The first trials were made on October 13, 1903, each propeller carrying a single screw of three blades of 32 inches diameter, and 30 inches pitch. The following table (Table C) gives a summary of the results obtained by progressively increasing the pressure of steam supplied to the high-pressure turbine. In the first run no steam was supplied to the turbines, the reciprocating engine alone being employed, and the turbines turning idly by the action of the water on the propellers.

In the diagram (Fig. 5) the mean speed of the vessel in knots is given along the base line, and the diagram shows:—

Curve A—Steam pressure in the turbines.

Curve B—Slip of the screw with reciprocating engines.

Curve C—Slip of the screw with high-pressure turbines.

Curve D—Slip of the screw with low-pressure turbines.

It will be seen from the above diagram that the estimated speed of 25 knots was obtained at the first trial, although the turbines were never working at the full effective pressure allowed for in the design, viz., 156 pounds. The curves of the slip of the screws shows that at 21 knots speed the propeller surface is sufficient, but above this speed it is rather too small, and it was consequently decided to increase its surface by adding a second propeller to each of the shafts.

It is interesting to follow the variation in slip of the different screws, as the power of the turbines is increased. With no steam in the turbines, and the vessel being propelled by the reciprocating engine alone at a speed of about 12 knots, the slip of the central propeller is about 40 per cent., while the water causes the wing propellers to turn the turbines at the rate of about 400 revolutions per minute. As the power of the turbines increases, the slip of the middle screw is reduced to about 7 per cent., while the slip of the turbine propellers, on the contrary, beginning at zero, increases progressively to upwards of 30 per cent. for the high-pressure turbine and 39 per cent. for the low-pressure turbine propeller. The difference between these two figures arises from the fact that the low-pressure turbine gives notably more power than the high-pressure turbine, owing to its condenser being better than was expected.

Owing to the considerable reduction in the slip of the central propeller, as the wing propellers come more and more into play, the speed of rotation of the reciprocating engine does not increase in proportion to the speed of the vessel. By referring to the table, it will be seen that, at the reduced speed of 12 knots, the speed

of rotation of the reciprocating engine is 369 revolutions, and at 25 knots (or double the first speed) only 516 revolutions per minute. On examining the curves of the turbines, it will be seen that their speed of rotation rises from 393 to 1,455 revolutions for the high-pressure turbine, and from 395 to 1,657 for the low-pressure turbine, while the speed of rotation allowed for in the design was 1,500 to 1,600 revolutions per minute. As regards the steam consumption, with the combined system of engines, this is very moderate at a speed of 10 knots, and probably considerably less than when reciprocating engines, equal to the full power required, are worked at very low powers.

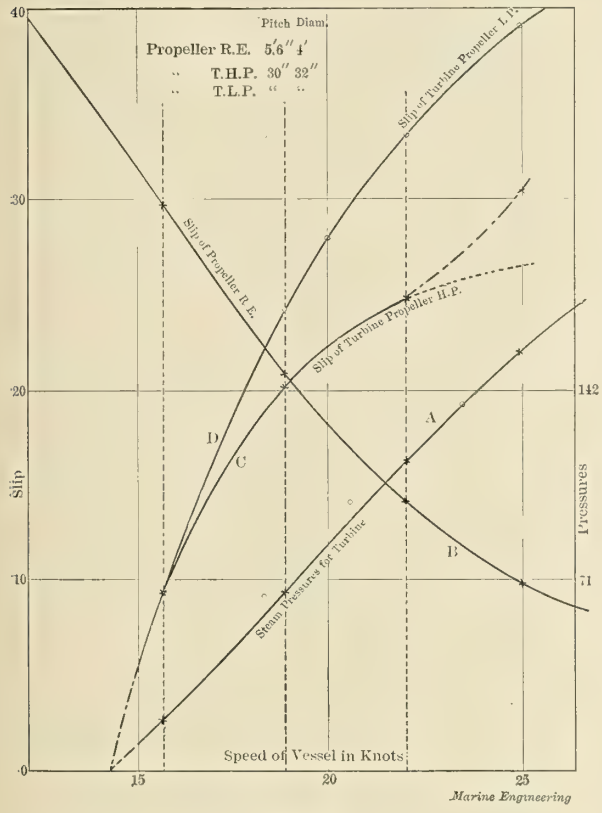


FIG. 5.

Second Trials.—A second series of trials was made on January 19, 1904, after the propellers had been altered, the middle one being reduced to 3 feet 6 inches diameter, the pitch being kept at 5 feet 6 inches. The high-pressure turbine was fitted with propellers of 2 feet 4 inches and 2 feet 8 inches diameter respectively, but both of the same pitch, while the low-pressure turbine was fitted with propellers of 2 feet 4 inches and 2 feet 10 inches diameter, and 2 feet 6 inches and 2 feet 10 inches pitch respectively. The results obtained are summarized in Table D.

It will be seen that a speed of 26.39 knots has been obtained by giving the turbines rather more steam than they had been designed for. For the same steam pressure at admission—that is, for same steam consumption—the speed is less than in the first trials except at the maximum speed, when it is about the same. The slip of the screws is much reduced, as also the speed of rotation of the turbines. It may, therefore, be inferred that two screws give better results than the single screw originally employed; for, the speed of rotation of the turbines having been greatly reduced, their efficiency is much less. To increase this speed and obtain the estimated efficiency, the propeller surface must be reduced, and this was done for the third series of trials.

A point of interest is that the addition of a screw revolving in the neighborhood of the hull gave rise to considerable vibration, whereas in the first trials the complete absence of vibration was specially noteworthy.

Third Trials.—A third set of trials was made on March 4, 1904, with propellers all of the same pitch (2 feet 6 inches) and rather smaller diameter (2 feet 6 inches, 2 feet 4 inches, 2 feet 1 inch). The speeds obtained were approximately equal to those of the second trials, for the same steam pressures in the H.P. turbine, but the speeds of rotation of the turbines were increased by 16 per cent. The increase in the efficiency of the engines was therefore balanced by the reduction in the efficiency of the screws, the slip of which rose to 24.6 per cent. for those of the H.P. turbine, and 33.1 per cent. for those of the L.P. turbine. It seems to be difficult to obtain more than this with propellers grouped in pairs on each shaft. This arrangement of two propellers, one in front of the other, is defective, in so far that the second propeller works in water already disturbed by the first propeller. The highest efficiency is certainly obtained with a single propeller on each shaft, but, in order that the slip should not exceed 25 per cent., which seems to be the maximum for a good duty, the propelling surface, and consequently the diameter, must be increased. This can be easily done when the shafts are nearly horizontal. On Messrs. Yarrow's boat, the inclination of the shafts is rather steeper than it should be with propellers having a diameter greater than the pitch. Nevertheless, the speed of 26.4 knots, which has already been obtained, is no doubt capable of being improved upon, and the maximum obtained with reciprocating engines can no doubt be easily reached.

In conclusion, it will be seen from what has been said, that steam turbines can be made practically equal to reciprocating engines for propelling ships at high speeds, but in order to obtain their full effect, they must be mounted upon shafts very slightly inclined, and, if possible, with only one propeller on each shaft. The necessity for having horizontal shafts leads to a more sudden rise in the hull aft than is usual when reciprocating engines are installed. Hence hulls constructed for reciprocating engines are not generally suitable for steam turbines. It must not be concluded from the fact that, *cæteris paribus*, a higher speed is not obtained by merely substituting turbines for reciprocating engines, that the former are therefore inferior to the latter. A new form of propelling engine obviously calls for new lines of hull. At reduced speeds, the turbines are not economical, and they are inconvenient for going astern and for manœuvring, but this drawback can quite well be remedied by combining turbines with a reciprocating engine, working a special shaft and mechanically independent of the turbines. Another arrangement, different from that in the Yarrow boat, whereby the reciprocating engine would supply about 40 per cent. of the total power, would give an increase

of 15 to 20 per cent. of the power obtained with a reciprocating engine alone, besides having the general advantages characteristic of turbines.

TABLE A.

Torpedo Boat No. 243. Trials of January 22, 1903.
Six propellers: Diam., 23.6 inches; Pitch, 19.7 inches.

Number of Trial.	I.	II.	III.	IV.
Speed of vessel (in knots)—mean of three runs....	17.07	19.59	20.94	21.26
Rotation of turbines—revs. per minute	1,348	1,572	1,748	1,774
Effective pressure of steam on admisson to turbines—pounds per square inch	68.26	100.98	129.42	132.26
Condenser vacuum—inches	28	28	27	27.5
Mean slip of propellers	0.217	0.230	0.260	0.260

With the other arrangement of propellers (20.9 inches pitch and 23.6 inches diameter), the following results were obtained:—

TABLE B.

Torpedo Boat No. 243. Trials of December 6, 1902.
Propellers: Diam., 20.9 inches; Pitch, 23.6 inches.

Number of Trial.	I.	II.	III.	IV.	V.
Speed of vessel (in knots)—mean of two runs	14.90	16.59	18.73	18.83	20.89
Rotation of turbines—revs. per miuute	1,051	1 213	1,386	1.392	1.556
Effective pressure of steam on admission to turbines—pound per square inch	104.5	80	?*	99.5	115
Condenser vacuum—inches	26.4	26.4	26	26.4	26.8
Mean slip of propellers	0.279	0.304	0.311	0.311	0.316

The torpedo boat No. 243 was built by the Société des Forges et Chantiers de la Méditerranée, at Havre, where its trials were run.

TABLE C.

Messrs. Yarrow & Company's Torpedo Boat. Trials of October 13, 1903.
Wind rather strong.

Number of Trial.	I.	II.	III.	IV.	V.
Number of runs on measured mile	3	2	2	2	3
Effective pressure of steam on admission to H. P. turbine—pound per square inch	—	50	50	100	145
Condenser vacuum—inches	26.8	28	28	27.2	26.9
Speeds attained in various runs (in knots)	10.68	17.39	20.66	23.84	27.69
	13.50	13.70	16.76	20.00	22.36
	10.30	—	—	—	27.48
Mean speed of vessel (in knots)	11.98	15.54	18.71	21.92	24.97
Rotation of reciprocating engine—revs. per minute	369	411	441	475	516
Rotation of H. P. turbine—revs. per minute	393	688	955	1,172	1 455
Rotation of L. P. turbine—revs. per minute	395	687	994	1.357	1.657
E. H. P. developed on shaft of reciprocating engine	239	260	251	235	232
Slip of propellers—					
Reciprocating engine—per cent	39.5	29.7	21.0	14.0	9.7
H. P. turbine—per cent	—	8.9	20.6	24.5	30.5
L. P. turbine—per cent	—	8.9	24.0	35.0	39.0

The E. H. P. developed on shaft was arrived at by deducting 10 per cent. from the H. P. recorded by the watt indicator.

*Owing to the failure of the gauges, the pressures in the turbines could not be taken on this trial.

TABLE D.

Messrs. Yarrow & Company's Torpedo Boat. Trials of January 19, 1904.

Number of Trial.	I.	II.	III.	IV.
Effective pressure of steam on admission to H. P. turbine—pound per square inch	50	100	150	170
Condenser vacuum—inches	28	27.5	27	27
Speed of vessels (two runs)—knots.	15.58	19.25	23.22	25.714
	20.00	23.53	26.67	27.067
Mean speed of vessel—knots	17.79	21.39	24.94	26.39
Rotation of reciprocating engine—revs. per minute	458	508	555	576
Rotation of H. P turbine—revs. per minute	836	1 052	1,207	1,258
Rotation of L. P. turbine—revs. per minute	836	1,065	1.232	1,307
Slip of propellers—				
Reciprocating engine—per cent	28.7	22.4	17	15.3
H. P. turbine—per cent	13.6	17.4	16.4	14.8
L. P. turbine—per cent	24.0	28.2	27.8	27.8

AMENDED STEAMBOAT RULES AND REGULATIONS.

At the regular annual meeting of the Board of Supervising Inspectors, Steamboat Inspection Service, held in Washington, D. C., in January and February, 1904, amendments were made to some of the sections of the general rules and regulations.

Following is the text of the rules amended in part only, the parts struck out inclosed in brackets [thus], while the additions to such paragraphs are printed in *italics*. Entirely new sections and paragraphs of sections are in plain type preceded by the word (new) in parentheses.

RULE II.

Section 14.

14. Corrugated furnace flues constructed with corrugations 8 inches from center to center, the radius of outer corrugation being not more than one-half of the reverse or suspension curve, the plain parts at the ends not exceeding 9 inches in length, made of plates not less than 5-16 of an inch thick, when new, corrugated with practically true circles, shall be allowed a steam pressure in accordance with the following formula:

$$\text{Pressure in pounds} = \frac{[15{,}000]\ 14{,}000}{D} \times T.$$

Where T = thickness in inches,
D = mean diameter in inches.

Section 28. (First four paragraphs new.)

28. The areas of all safety valves on boilers contracted for or the construction of which commenced on or after July 1, 1904, shall be determined in accordance with the following formula and table:

$$\text{Formula: } a = .2074 \times \frac{W}{P}.$$

Where a = area of safety valve, in square inches, per square foot of grate surface.

W = pounds of water evaporated per square foot of grate surface per hour.

P = absolute pressure per square inch = working gauge pressure + 15.

From which formula, the areas required per square foot of grate surface, in the following table,* are found by assuming the different values of W and P.

*The table is not given in this magazine, as it is simply derived from the above formula.

The figures (*a*) in table multiplied by square feet of grate surface give the area of safety valve or valves required.

When this calculation results in an odd size of safety valve, use next larger standard size.

Any spring-loaded safety valve constructed so as to give an increased lift by the operation of steam, after being raised from its seat, or any spring-loaded safety valve constructed in any other manner so as to give an effective area equal to that of the aforementioned spring-loaded safety valve, may be used in lieu of the common lever-weighted valve on all boilers on steam vessels, and each spring-loaded valve shall be supplied with a lever that will raise the valve from its seat a distance of not less than that equal to 1-8 of the diameter of the valve opening. But in no case shall any spring-loaded safety valve be used in lieu of the lever-weighted safety valve without first having been approved by the Board of Supervising Inspectors.

The valves shall be so arranged that each boiler shall have at least one separate safety valve, unless the arrangement is such as to preclude the possibility of shutting off the communication of any boiler with the safety valve or valves employed. This arrangement shall also apply to lock-up safety valves when they are employed.

The use of two safety valves may be allowed on any boiler, provided the combined area of such valves is equal to that required by rule for one such valve.

The seats of all safety valves shall have an angle of inclination of 45 degrees to the center line of their axes.

All common lever safety valves to be hereafter applied to the boilers of steam vessels must be constructed in material, workmanship, and principle according to the drawings for a safety valve referred to in this section.

RULE V.

SECTION 14. (New, inserted after seventeenth line of first paragraph.)

Practical service in the deck department of a steam yacht of over 100 tons, cruising on inland waters, when offered in documentary evidence by a person applying for a pilot license or raise of grade, shall be accepted as being equal to the same amount of service on any inland passenger vessel.

SECTION 14. (New, inserted before the word "*Provided*" in fourteenth line of third paragraph.)

Practical service in deck department of an ocean-going or coastwise steam yacht shall be accepted when offered in documentary evidence by any person applying for an original license or raise of grade on ocean-going or coastwise steam vessels as being equal to the same amount of service in any ocean-going or coastwise steam passenger vessel.

SECTION 14. (New, at end of section.)

And the holder of a license as a first-class pilot may have the same indorsed, without examination, as master of lake, bay, sound, or river steamer of 150 tons or under engaged exclusively in towing.

SECTION 25. (First paragraph.)

25. Starting, stopping, and backing signals for steam vessels navigating the waters of the eighth and ninth supervising inspection districts, and so much of Lake Superior as is included in the fifth district, *excepting the waters of Lake Champlain.*

SECTION 27. (Second paragraph.)

Whenever the owner or sailing master of a steam or sailing yacht [of over 100 gross tons], who has had three years' experience in sailing such vessels, applies for a license authorizing him to act as master of steam yachts for coastwise and ocean navigation, the local inspectors shall examine the applicant . . . (Rest of paragraph unchanged.)

RULE VI.

SECTION 7. (First paragraph.)

7. Certificates of inspection for any period less than one year shall not be issued, but nothing herein shall be construed as preventing local inspectors from inspecting steamers for renewal of certificate, upon due application in writing, at any time not exceeding [ten] *thirty* days of expiration of current certificate of inspection, providing the same can be done without greater expense than would be incurred if taking place when inspection is regularly due, and that such inspection shall not interfere with other inspections regularly falling due at the same time. This rule, however, is not to be construed as preventing the inspection of any steamer at an earlier period than [ten] *thirty* days anterior to the expiration of the steamer's certificate, when such steamer has been practically rebuilt, or when necessary "for the purpose of concentrating the work of the inspectors within certain given periods" . . . for the purpose of saving traveling expenses, or in the case of sea-going steamers, foreign or coastwise, whose inspection certificates would expire on a voyage previous to the return of the vessel to the port where usually inspected.

Several forms of new appliances were approved by the board, including life preservers, life boats, fusible plugs, boilers, etc.

The above amendments to the rules received the approval of the Secretary of Commerce and Labor and now have the force of law.

CONGRESSIONAL MARITIME LEGISLATION.

The last Congress passed several measures tending to aid American shipping. The Gardner bill, as mentioned in a previous issue, provides for a commission of five senators and five representatives to inquire into the state of the merchant marine and report to the next Congress. This commission has held its first session and has laid out a comprehensive line of work for the summer. Other bills are given in full below.

CARRYING GOVERNMENT SUPPLIES IN AMERICAN SHIPS.

"*Be it Enacted by the Senate and House of Representatives of the United States of America in Congress Assembled.* That vessels of the United States or belonging to the United States, and no others, shall be employed in the transportation by sea of coal, provisions, fodder, or supplies of any description, purchased pursuant to law, for the use of the army or navy unless the president shall find that the rates of freight charges by said vessels are excessive and unreasonable, in which case contracts shall be made under the law as it now exists: *Provided,* That no greater charges be made by such vessels for transportation of articles for the use

of the said army and navy than are made by such vessels for transportation of like goods for private parties or companies.

"SEC. 2. That this act shall take effect sixty days after its passage."

MINIMUM TONNAGE OF VESSELS IN FOREIGN TRACT.

"Be it Enacted by the Senate and House of Representatives of the United States of America in Congress Assembled, That section 3,095 of the Revised Statutes is hereby amended so as to read as follows:

"SEC. 3,095. Except in the districts on the northern, northwestern, and western boundaries of the United States, adjoining to the Dominion of Canada or into the districts adjacent to Mexico, no merchandise of foreign growth or manufacture subject to the payment of duties shall be brought into the United States from any foreign port in any other manner than by sea, nor in any vessel of less than 30 net register tons, or landed or unladen at any other port than is directed by law, under the penalty of seizure and forfeiture of all such vessels and of the merchandise imported therein, laden or unladen in any other manner.

"SEC. 2. That this act shall take effect one month after its passage."

PHILIPPINE SHIPPING BILL.

Be it Enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That on and after July 1, 1906, no merchandise except supplies for the army and navy, shall be transported by sea, under penalty of forfeiture thereof, between ports of the United States and ports or places in the Philippine archipelago, directly or via a foreign port, or for any part of the voyage, in any other vessel than a vessel of the United States. But this section shall not be construed to prohibit the sailing of any foreign vessel between any port of the United States and any port or place in the Philippine archipelago: provided, That no merchandise other than that imported in such vessel from some foreign port which has been specified on the manifest as for another port, and which shall not have been unloaded, shall be carried between a port of the United States and a port or place in the Philippine archipelago.

SEC. 2. That on and after July 1, 1906, no foreign vessel shall transport passengers between ports of the United States and ports or places in the Philippine archipelago, either directly or by way of a foreign port, under a penalty of $200 for each passenger so transported and landed.

SEC. 3. That sections one and two of this act shall not apply to the transportation of merchandise or passengers between ports or places in the Philippine archipelago. Until congress shall have authorized the registry as vessels of the United States of vessels owned in the Philippine archipelago, the government of the Philippine Islands is hereby authorized to adopt, from time to time, and enforce regulations governing the transportation of merchandise and passengers between ports or places in the Philippine archipelago.

SEC. 4. That sections one and two of this act shall not apply to the voyage of a vessel between a port of the United States and a port or place in the Philippine archipelago begun before July 1, 1906.

SEC. 5. That sections one and two of this act shall not apply to vessels owned by the United States.

SEC. 6. That on and after the passage of this act the same tonnage taxes shall be levied, collected, and paid upon all foreign vessels coming into the United States from the Philippine archipelago which are required by law to be levied, collected, and paid upon vessels coming into the United States from foreign countries: *Provided, however,* That until July 1, 1906, the provisions of law restricting to vessels of the United States the transportation of passengers and merchandise directly or indirectly from one port of the United States to another port of the United States shall not be applicable to foreign vessels engaging in trade between the Philippine archipelago and the United States: *And provided further,* That the Philippine Commission shall be authorized and empowered to issue licenses to engage in lighterage or other exclusively harbor business to vessels or other craft actually engaged in such business at the date of the passage of this act, and to vessels or other craft built in the Philippine Islands or in the United States and owned by citizens of the United States or by inhabitants of the Philippine Islands.

SEC. 7. That this act shall not be construed to impair or affect any privilege guaranteed to Spanish ships and merchandise by the treaty of peace between the United States and Spain signed at the city of Paris on December 10, 1898, and ratified April 11, 1899.

SEC. 8. That the Secretary of Commerce and Labor shall, from time to time, issue regulations for the enforcement of this act, except as otherwise provided in section three: *Provided,* That such of the navigation laws of the United States as are in force in the Philippine archipelago in regard to vessels arriving in the Philippine Islands from the mainland territory and other insular possessions of the United States shall continue to be administered by the proper officials of the government of the Philippine Islands.

Progress of Naval Vessels.

The Bureau of Construction and Repair, Navy Department, report under date of May 9, 1904, the following degree of completion of vessels building for the United States Navy:

				Degree of Completion. Per Cent.	
BATTLESHIPS.				Apr. 1.	May 1.
Ohio	18 knots.	Union Iron Works		91	93
Virginia	19 "	Newport News Co		56.8	59.4
Nebraska	19 "	Moran Brothers Co		44.5	46.9
Georgia	19 "	Bath Iron Works		49.91	52
New Jersey	19 "	Fore River S. and E. Co		55.3	57.6
Rhode Island	19 "	Fore River S. and E. Co		57	59.8
Connecticut	18 "	Navy Yard, New York, N Y.		34.56	38.46
Louisiana	18 "	Newport News Co		44.27	47.91
Vermont	18 "	Fore River S. and E. Co		5.6	6.8
Kansas	18 "	New York Shipbuilding Co.		6.3	7.5
Minnesota	18 "	Newport News Co		21.65	26.15
Mississippi	17 "	Wm. Cramp and Sons		0.7	2.3
Idaho	17 "	Wm. Cramp and Sons		0.6	2.2
ARMORED CRUISERS.					
Pennsylvania	22 knots.	William Cramp and Sons		71.2	76.9
West Virginia	22 "	Newport News Co.		80.25	83.4
California	22 "	Union Iron Works		58	60
Colorado	22 "	William Cramp and Sons		77.5	80.9
Maryland	22 "	Newport News Co		75.88	78.88
South Dakota	22 "	Union Iron Works		54	55.5
Tennessee	22 "	William Cramp and Sons		23.4	28.9
Washington	22 "	New York S. B. Co		20.9	24.2
PROTECTED CRUISERS.					
Denver	17 knots.	Neafie and Levy		99	99.9
Des Moines	16½ "	Fore River S. and E. Co		100	
Chattanooga	16½ "	Lewis Nixon		75.71	80.01
Galveston	16½ "	Wm. R. Trigg Co		75	78
St. Louis	22 "	Neafie and Levy Co.		40.9	41.2
Milwaukee	22 "	Union Iron Works		46	48
Charleston	22 "	Newport News Co		67.2	69.7
GUNBOATS.					
Dubuque	12 knots.	Gas Engine and Power Co.		33.5	40
Paducah	12 "	Gas Engine and Power Co.		29.1	33.6
TRAINING SHIPS.					
Cumberland	Sails	Navy Yard, Boston		28.5	35
Intrepid	"	Navy Yard, Mare Island		12	16
TRAINING BRIG.					
Boxer	Sails	Navy Yard, Portsmouth		28	34
TORPEDO BOATS.					
Stringham	30 knots.	Harlan and Hollingsworth		93	93
Goldsborough	30 "	Wolff and Zwicker		99	99
Blakely	26 "	George Lawley and Son		99	99
Nicholson	26 "	Lewis Nixon		99	99
O'Brien	26 "	Lewis Nixon		98	98

NEW HUDSON RIVER STEAMBOAT C. W. MORSE.

STEAMBOAT C. W. MORSE, FOR THE HUDSON RIVER.

The steamer *C. W. Morse,* which has just been completed for the Peoples' line between New York and Albany, is one of the largest side-wheel steamboats afloat. The vessel was designed by Mr. J. W. Millard, naval architect, of New York. The *Morse* will be the running mate of the steamer *Adirondack,* built for this line eight years ago. While the new steamer is about 30 feet longer than the *Adirondack,* and resembles her in many respects, the hull up to main deck is built of steel, and, in place of the cumbersome hog frame, the fore-and-aft strength is secured by longitudinal girders worked in on either side of main deck on a line with the steel hull and wheel-battery bulkheads. Much space is gained by this change, and the boat presents a far more graceful appearance. The over-all length is 430 feet; the beam, molded, 50 feet 6 inches; over guards, 90 feet; and the depth, molded, 14 feet 6 inches. With such a shallow hull, where the ratio of breadth to depth is as high as 3.5 to 1, special consideration had to be given to fore-and-aft strength. The channel of the Hudson river at the upper end is not deep, therefore it is necessary that boats be of very light draft. The load draft of the *Morse* is but 9 feet, and it was necessary to keep the weights of scantling down to the very lightest consistent with strength. By referring to page 282 the reader will see the way in which the designer carried out this problem in the distribution of weight. The longitudinal girders, before referred to, take the greater part of this above main deck. Two lattice girders, six keelsons, and four side stringers, besides the usual plating and center keelson, take care of the strains below deck.

Another feature to be noticed is the truss for supporting the overhang of the guards. Rigid support is given by angle-iron trusses with deep-flanged brackets alternating with pipe stanchions; at the same time the sponsons clear the water line by 18 inches at the lowest point.

The hull was built by the Harlan & Hollingsworth Company, Wilmington, Del., the joiner work by C. M. Englis, and the engine and boilers were built and installed by the W. & A. Fletcher Company, Hoboken, N. J. No expense has been spared in her design and construction to make her as safe and comfortable as possible.

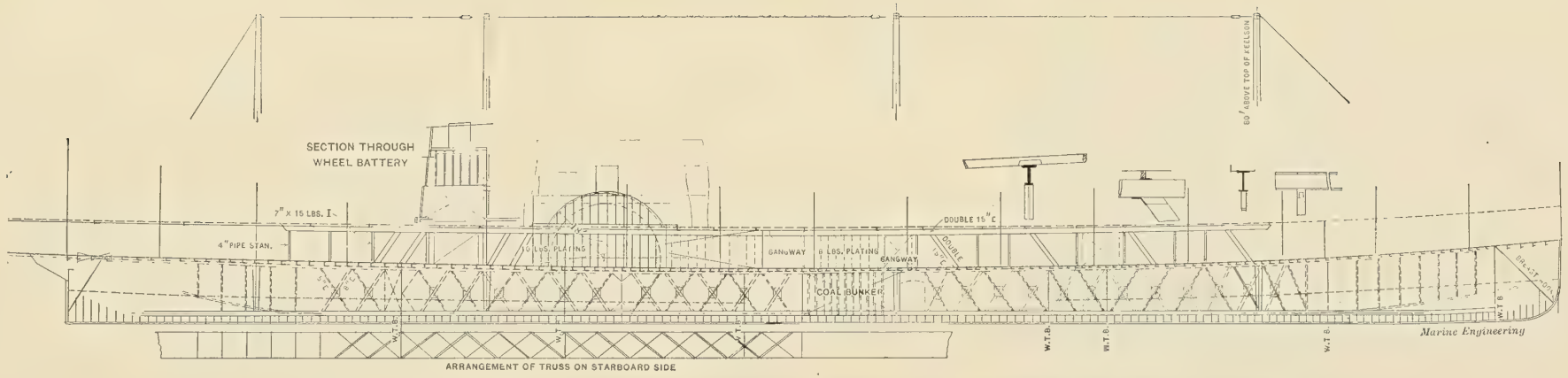
Some idea of the size of the vessel can be obtained by the statement that the area of all the deck is 135,000 square feet, or about three acres.

GENERAL ARRANGEMENT.

The hull is divided into eight water-tight compartments by seven thwartship steel bulkheads to main deck. A lower deck of wood extends fore and aft except in way of boiler rooms. Directly aft the forward collision bulkhead is a space 46 feet long devoted to the crew's quarters, accommodating 18 firemen and 18 deck hands. In the next compartment, which is 60 feet 6 inches long, are berths for men passengers who do not purchase state rooms. There are in all 116 berths. The dynamo room, 16 feet fore and aft by the full width of the vessel, comes next, and is located directly forward of the boilers. In this are placed three 50-Kw. General Electric direct-connected generators and switchboard. The two-wire system is used for distribution, the mains being laid in iron conduit, and there are in all 2,500 16-c. p. lamps through the cabins, etc. Current is also supplied to a 36-inch searchlight placed on the pilot house.

The boiler room is 83 feet fore and aft, and contains four lobster-back return-flue boilers placed fore and aft with the common fire room. Wing coal bunkers, with a capacity for 200 tons, are located on either side.

A space 50 feet fore and aft is devoted to main engine auxiliary machinery, and aft of this is a compartment 45 feet by 45 feet suitably divided for bar room, kitchen, and pantries, and sleeping quarters for employees in the



LONGITUDINAL ELEVATION SHOWING ARRANGEMENT OF FORE-AND-AFT GIRDERS ON THE SHALLOW-DRAFT STEAMBOAT C. W. MORSE.

steward's department. A wide stairway leads from the pantry to the dining room above for the use of the waiters. The bar room is entered through a stairway leading from the boot-black parlor. The remaining space aft is fitted up for sleeping accommodations for 66 women passengers and stewardesses on the port side, and 55 men passengers on the starboard side. Access to the women's cabin is by means of a stairway leading from the saloon and main decks.

Most of the space forward on the main deck is for the carrying of freight. The steam-steering gear is placed directly below the pilot house on this deck. At the bow there is windlass and space for the handling of lines, etc. Abreast the engine and boiler-room casings are store rooms and a pump room and the wheel batteries, that space alongside the engine casing being reserved for the baggage of passengers.

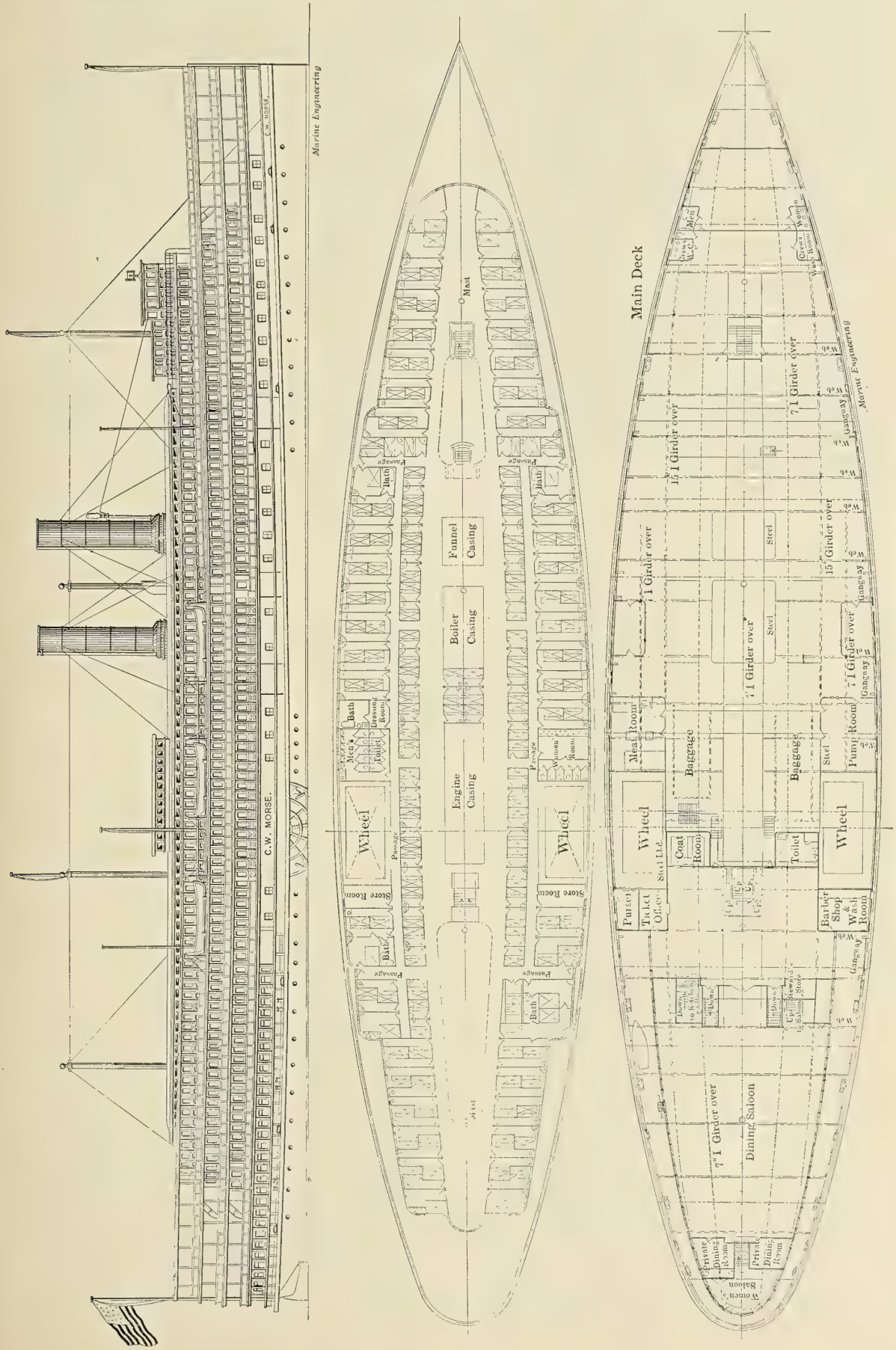
The after end of this deck is devoted entirely to an immense lobby and dining room. Gangways on either side open into this lobby or quarter deck, which is richly finished. Forward is a stairway of mahogany leading to the main saloon above, while directly opposite this is the dining saloon with large windows closely set around three sides. This dining room is 110 feet long and seats 300 people comfortably. There are in addition, at the after end of the main room, two handsomely-finished private dining rooms. The wood work is mahogany richly carved, and the ceiling in delicate white and gold. By night the room is illuminated by 225 electric lights mounted on bronze green fixtures. A promenade runs around the outside of the dining room.

Opening from the quarter deck are the purser's office, barber shop, wash room, coat room, etc. Ascending the main stairway the passenger finds himself in the grand saloon, extending almost the entire length of the steamer. It is here that he gets his first impression of the enormous size of the vessel. There is an unobstructed view to the dome on the top deck 28 feet above. There are two galleries with mahogany guard rails and green bronze grill work opening into the saloon, and on all decks state rooms are so arranged that there are very few inside rooms, and, in fact, none which are not freely ventilated. The color scheme is carried out in white and gold with a touch of green, with none of the over decoration and garishness often found on steamers.

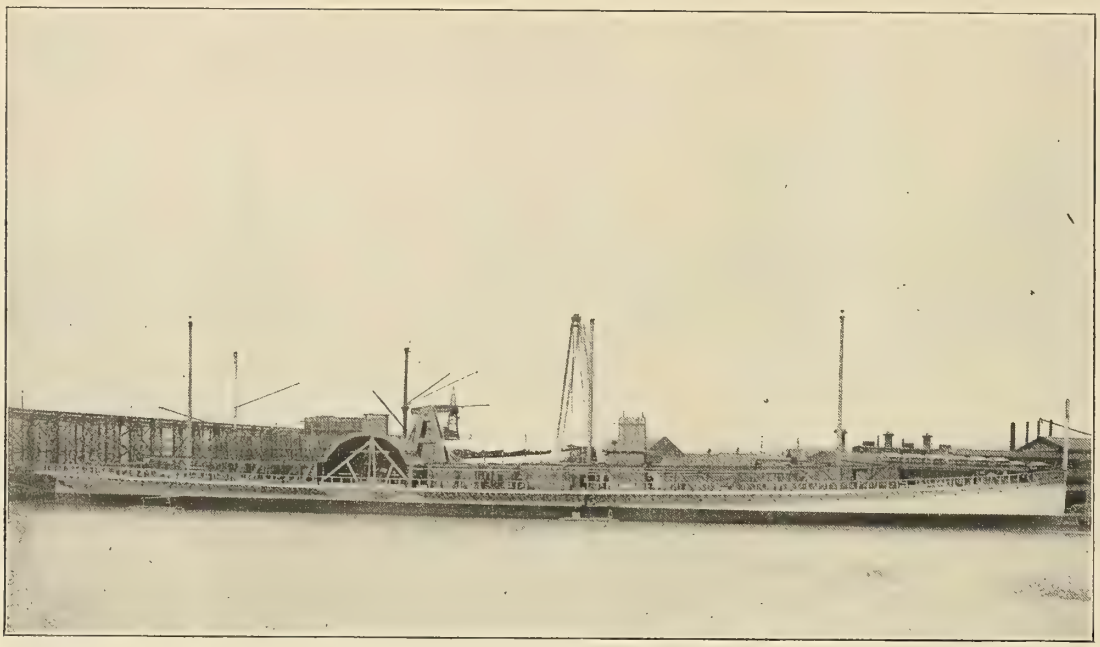
For about 125 feet amidships the state rooms run clear out to the side of the ship in line with the wheel battery. The outside panels of the wheel house and these state rooms are the same; that is, there is no break in the shear, thus keeping the whole side of the vessel symmetrical. The remainder of the cabins set back allowing ample room for promenade space. The feature aimed at has been to give most of the passengers outside rooms, and this is carried out in a manner as shown in the deck plans on page 281. The only inside rooms are those amidships, and these have windows on the outside opening into a broad, well-lighted corridor. From this corridor other rooms are entered. There are a number of cabin de luxe, with tapestried walls and ceilings in ivory and gold. These parlors are furnished with brass bedsteads and have private baths and toilets adjoining. There are also several bath rooms, for the use of passengers occupying rooms without attached baths. The passenger accommodations on this deck are: 14 large outside parlor rooms; 70 state rooms, 140 berths, outside rooms; 58 state rooms; 116 berths, inside rooms.

The gallery deck is arranged practically in the same manner as the saloon deck and has accommodations as follows: 12 large outside parlor rooms; 92 state rooms, 184 berths, outside rooms; 58 state rooms, 116 berths, inside rooms.

The upper gallery deck is somewhat differently arranged in that the cabins do not extend to the side of the boat but run in a continuous line all fore and aft,



PROFILE AND DECK PLANS OF THE NEW HUDSON RIVER STEAMBOAT C. W. MORSE.



STEEL HULL OF THE C. W. MORSE, READY TO BE TOWED FROM WILMINGTON, DEL., TO NEW YORK, FOR ENGINES AND JOINER WORK.

allowing an unobstructed promenade. Amidships on this deck are stowed the boats and life rafts. At the end is a large palm garden with café adjoining. The accommodations are: 84 outside state rooms, 168 beds, and 6 inside state rooms, 12 beds. Thus there are 402 rooms in all.

The dome deck extends the length of the upper gallery cabin inclosure and furnishes light and ventilation to the remainder of the boat. At the forward end is the pilot house and adjoining it are the quarters for captain and officers. The floor of the pilot house is about 40 feet above the water level.

The *Morse* has four steel masts 85 feet long by 24 inches diameter and two smoke stacks 6 feet 2 inches diameter and 95 feet 6 inches above the keel.

MACHINERY.

The main engine is a duplicate of the *Adirondack's,* of the simple vertical-beam surface-condensing type, built for 50-pounds pressure. The cylinder is 81 inches diameter and the stroke 12 feet. The paddle wheels are of the feathering type, built of steel, 30 feet outside diameter of buckets, with 12 buckets 12 feet 11 1-2 inches long. The shafts, which are overhung, are 24 inches diameter. When making 27 revolutions the engine will indicate 4,500 horse power, which is estimated will give a speed of 17 knots under favorable conditions. The air pump, direct-connected to the beam, is 47 inches diameter, and has a stroke of 51 inches. There are 6,153 square feet of cooling surface in the condenser. The total heating surface of the four boilers up to the water line is 9,000 square feet. Each boiler has superheating surface in the chimneys.

The boilers are four in number, arranged with axes fore and aft and opening into a common fire room. They are built for a pressure of 55 pounds and are 33

MARINE ENGINEERING DATA CARD. **JUNE, 1904.**

NAME—C. W. Morse. NATIONALITY—American. TYPE—River passenger steamboat.

LAUNCHED—1902. BUILDERS—Harland and Hollingsworth Co., W. and A. Fletcher Co. OWNER—People's Evening Line.

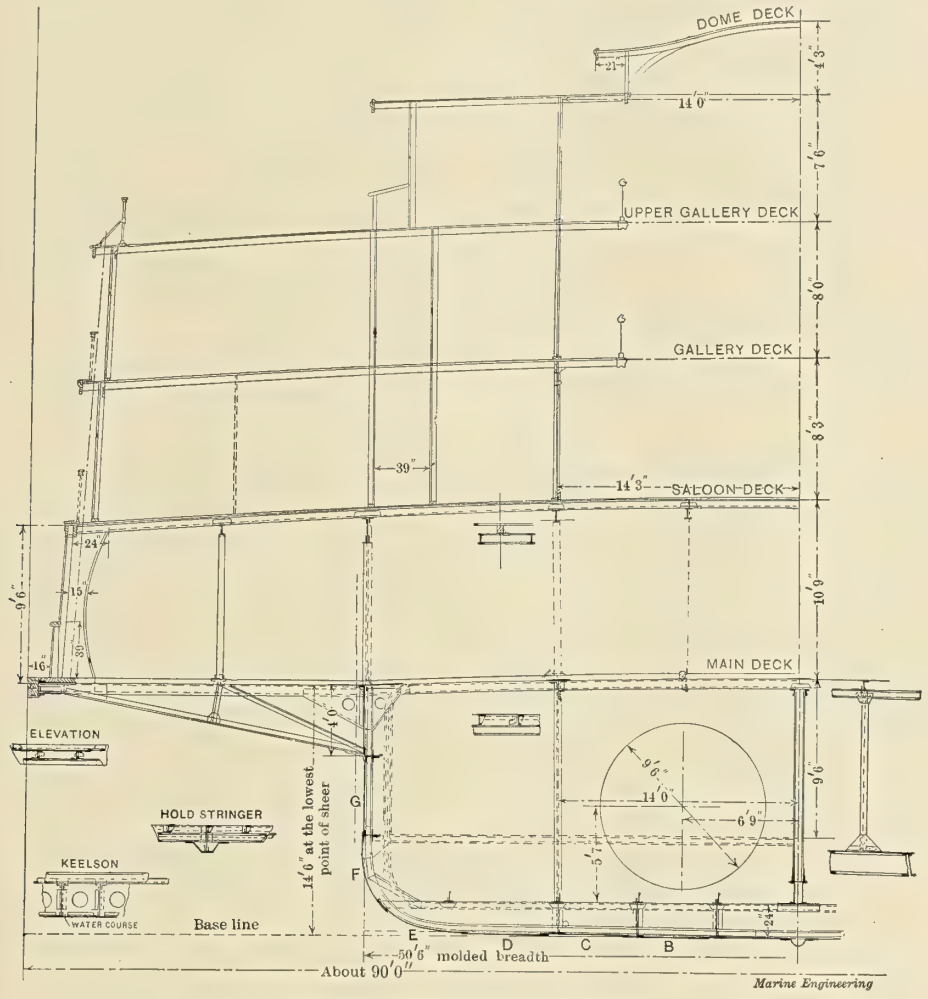
Length over all	430 ft. 0 ins.
" between perps	410 " 0 "
Beam, molded	50 " 6 "
" over guards	90 " 0 "
Depth, molded	14 " 6 "
Draft	9 " 0 "
Displacement	3,300 tons
Dead weight carrying capacity	1,000 "
Tonnage, gross	4,307 "
Engine: Type, walking beam paddle wheel	
Cylinder diameter	81 ins.
Stroke	12 ft.
Shafts, diameter	24 ins.
Air pump, diameter	47 "
" " stroke	4 ft. 3 ins.
Condenser tubes	3,346—3 4 ins O. D.
" " length	9 ft. 9 1-2 ins.
" cooling surface	6,153 sq. ft.
Wheels: Type, feathering buckets	
Diameter outside buckets	30 ft.
Buckets, length	12 ft. 11 1-2 ins.
" number	12
R. P. M., maximum	27
I. H. P., "	4,500
Speed, "	17 knots
Boilers: Number	4
Type	lobster back return flue
Length	33 ft. 0 ins.
Width at front	11 " 4 "
Diameter	9 " 6 "
G. S. 4 boilers	320 sq. ft.
H. S. to water line	9,000 " "
H. S. ÷ G. S.	28.1
H. S. ÷ I. H. P.	2.0
L. H. P. ÷ G. S.	14.1

feet long, 11 feet 4 inches wide across the fronts, and 9 feet 6 inches diameter. The steam chimneys on boilers are 7 feet 4 inches diameter by 10 feet 6 inches high. The boilers will be run ordinarily under natural draft, though, when necessary, forced draft may be used, as two blowers are provided to furnish air under the grates. The smoke boxes of the forward blowers lead to the forward stack and the smoke boxes from the after boilers to the after stack.

The vessel is classed under the United States Standard Register of Shipping.

The vessel is equipped throughout with electric bells, thermostatic push buttons, fire alarms, watchmen's clocks, and telephones for special service.

The complement of officers and men consist of, navigating department: captain, first and second pilot, two wheelsmen, and one lookout; engineer's department: chief engineer, two assistant engineers, four oilers, fifteen firemen; mates' department: first and second mate, two watchmen, fourteen deck hands, six deck boys; steward's department: steward, head waiter, chief cook, second and third cook, broiler, sink men, mess men, two



MIDSHIP SECTION STEAMBOAT C. W. MORSE.

The pumps, which are all of the Worthington pattern, are as follows:

Fire and wrecking, 1 duplex, 14 and 7 inches by 10 inches; 1 duplex, 16 and 17 inches by 10 inches.

Bilge, 1 admiralty, 7 1-2 and 6 inches by 6 inches.

Sanitary, 1 duplex, 7 1-2 and 4 1-2 inches by 10 inches.

Donkey boiler, 1 duplex, 4 1-2 and 2 3-4 by 4 inches.

There is one Worthington jet condenser for electric-lighting plant with a 14 and 12 inches by 10-inch pump.

A large donkey boiler is placed on main deck within the boiler inclosure. Special care has been taken to provide an effective fire system, there being 52 hose connections fitted on the four fire mains.

helpers, fireman, four pantry men, and fifty-two colored waiters, cashier, checker, barber, and bar tender.

OBITUARY.

John L. Weeks, treasurer and general manager of the American Steam Gauge and Valve Company, died suddenly in Boston on April 2, 1904, as the result of complications arising from an operation for appendicitis two years ago. Mr. Weeks was born in Akron, Ohio, thirty-eight years ago, and has been with the above-named company for fifteen years. He had a large acquaintance of friends throughout the country to whom his death is a great loss.

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Notice to Advertisers.

Changes to be made in copy, or in orders for advertisements, must be in our hands not later than the 15th of the month, to insure the carrying out of such instructions in the issue of the month following.

OUR readers will remember the discussions which appeared in these columns and throughout the technical press on the possible and probable consequences of the Naval Personnel bill of March 3, 1899, in consequence of which the former Engineer Corps of the navy was abolished as a separate corps and its members were amalgamated with the line branch of the service. The experience of four years seems to indicate that at least some part of the fears which were then expressed regarding the measure were not without some foundation, and it is perhaps not going too far to say that on all hands and among those most vitally interested the results have been disappointing in respect to the maintenance of the engineering skill necessary for the proper care and efficient operation of the machinery of our modern fleets. The effects of a measure of this character will depend on two main features: the provisions of the measure itself and the way in which they are interpreted and carried out by those charged with authority in the matter. In the present case it may perhaps be said that the measure was, on the whole, better than its execution. While not free from radical and, perhaps, fundamental faults, yet these might in some measure have been counteracted, and the engineering necessities of the situation better safeguarded by an interpretation of the measure in more intelligent sympathy with these aspects of the naval service.

However, we are not now so much concerned with the past as with the future. It may be admitted that, under the present adminisration of existing legislation, the present and future engineering needs of the naval service are not being properly safeguarded. The former highly-trained corps are wasting by natural causes and no means are in operation looking toward the provision of men with equal training, or of counteracting such wastage by the development of equally good material in the lower grades of the service. This condition, which has been repeatedly urged upon the Secretary of the Navy and upon Congress by the late Engineer-in-Chief, Admiral Melville, and his successor, Admiral Rae, has at last attracted the serious attention of the Secretary of the Navy, and a board was appointed for the consideration and study of the entire subject, the especial purpose being to devise some means which shall make good the wastage in the specially-trained body of engineers, and provide a body of officers on whom full reliance may be placed with regard to the interests of this vitally important aspect of the naval service.

This board has recently submitted its report, and, according to the public press, its most important features are intended to provide for the more acute needs through departmental regulation and not involving the necessity of congressional legislation. This is certainly wise, for it would seem most unfortunate to involve these important interests in the uncertainties of new legislation in Congress, and possibly to awaken controversies which were happily quieted by the legislation of 1899.

It is not alone in relation to the design, operation, and maintenance of marine propulsive and auxiliary machinery that present conditions have been felt quite unsatisfactory, but in relation to our modern ordnance as well. The production of modern high-powered guns and ordnance material involves engineering of the highest type, and the whole field of such work becomes, in fact, a branch of engineering, and those who are qualified therein become, in fact, engineers. This is further evidenced by the terms ordnance engineering and ordnance engineer, which are becoming so widely used in reference to the production

of modern ordnance. Here, again, our present naval organization is lacking, furnishing no proper provision for adequately-trained ordnance engineers, and no assurance that our modern guns and ordnance material can be kept up to or ahead of the front rank of the world's progress.

With these needs in view and upon the recommendation of this board, the Secretary of the Navy has recently directed that two junior lieutenants, four ensigns, and four midshipmen just completing their six years' course, shall be assigned to ordnance duty exclusively, and the same number of each grade to engineering duty exclusively. These assignments are to be made at once, and each year hereafter four midshipmen completing the six years' course are to be similarly assigned exclusively to ordnance duty and four to engineering duty. The officers thus assigned are to retain their positions in the line and those doing ordnance duty will also perform line duty at sea. The officers assigned to engineering duty exclusively will, on the other hand, not perform line duty at sea, and, as a compensation for not being able to enjoy the distinction which attaches to the duties of command rank at sea, it is provided that after attaining command rank they shall be assigned exclusively to shore duty.

The effect of carrying out these recommendations will be to create a new ordnance corps and a new corps of naval engineers, without depriving the officers of actual rank and title, and by means of a simple restriction in the character of the duty to which the officers in question are assigned.

There are other features in the report, reference to which lack of space prevents, and in particular with refeence to the education and training by means of which the officers thus specially assigned are intended to be prepared for their important duties. The significant point, however, lies in the fact that a move has been made. This implies a realization of the needs of the situation and a disposition to take such remedial measures as the most careful study can suggest. The question may naturally arise whether the special assignment of only four officers each year exclusively to engineering duty will prove adequate to the needs of the situation. Certainly it will give no more than a sprinkling here and there of such specially-trained men of any one grade or for any one type of duty; but this is better than the condition in the past, and the number may later be increased as experience demonstrates the need. The step is certainly one of the utmost potential importance and value, and if it is only carried out with a view of realizing its full possibilities it cannot but prove of the greatest value as a factor in maintaining our navy in a condition of the highest possible engineering efficiency.

AS we are going to press the first meeting of the Merchant Marine Commission is about to hold in New York city its first public hearing. In lieu of any legislation protecting American shipping generally this commission was appointed to "investigate and to report on the opening day of the next session of Congress what legislation, if any, is desirable for the development of the American merchant marine and American commerce, and also what change or changes, if any, should be made in existing laws relating to the treatment, comfort, and safety of seamen in order to make more attractive the seafaring calling in the American merchant marine." The commission is composed of five senators, five representatives, and an able secretary, and is subdivided into three committees, one to investigate specially into conditions on the Atlantic seaboard, another into the affairs on the Great Lakes, and a third committee will proceed to the Pacific. It is unnecessary to bring evidence before this commission that American shipping and shipbuilding is in a deplorable condition. The facts in the case are evident to any layman; the public hearings are for the purpose of finding out some specific practical way of averting the decline and building up these industries. From all indications the most practical way to accomplish this end appears to be through discriminating duties. The fate of several subsidy bills in Congress is proof that such a bill can never be passed. For all interested to unite on one feasible plan, and that one which offers the least resistance, is the only way in which to secure the desired legislation.

In other ways Congress has done considerable for American shipping. Elsewhere in these pages are given three bills passed to increase the commerce to be carried in American bottoms and to American ports. Carrying government supplies in American ships will bring many large ships into active service, and the extension of the shipping laws to the Philippines will create a demand for our vessels in the transpacific trade. The outlook on the Pacific is promising, but unless some general shipping legislation such as it is hoped the Merchant Marine Commission will recommend is passed, the deep-sea Atlantic trade must continue to pass into foreign hands.

Grounding and Repair of Steamer Franconia.

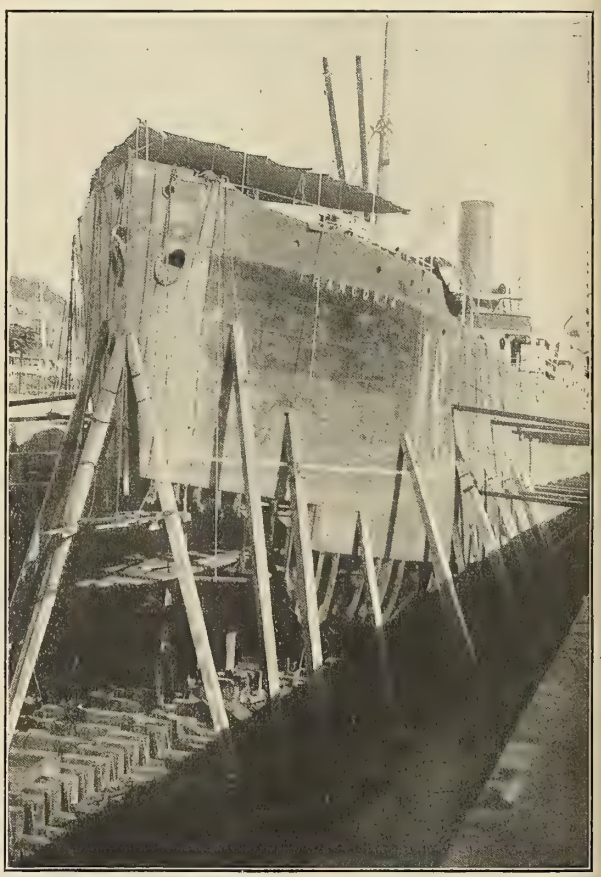
On the night of June 9, 1903, the Austrian steamer *Franconia,* laden with 7,000 tons of grain, bound from Odessa to Rotterdam, was carried ashore by a strong current off the Algerian coast, and struck on a submerged ledge named the Two Sisters. The lifeboat was at once lowered and part of the crew started for the port of Bona, which they reached safely; Captain Radonicic and the chief engineer, with a few of the crew, stayed on board. An examination of the damage showed that the bow of the vessel had been badly crushed in and the inner and outer plating of the bottom was bent up as far aft as No. 2 water-tight bulkhead. A bad sea and rough weather on the following day opened up the bottom still wider, and practically the entire cargo in the forward hold dropped through; this resulted in raising the forebody up to such an extent that the vessel was floated from the rocks on the second day.

AUSTRIAN STEAMER FRANCONIA AFLOAT AFTER GROUNDING.

Then the crew discharged the cargo of wood that was placed on deck, started up the engines, and proceeded slowly to Bona, where they arrived on the morning of June 11. Hold No. 1 was full of water, with 3 feet of water over No. 1 'tween-decks. Sounding showed that there was 6 feet of water at the forward end of No. 2 and 2 feet at the after end. The ship was then drawing 33 feet forward and 22 feet aft. At Bona 6,000 tons of cargo were discharged, and also 500 tons of ballast were lifted from the forward to the after end, and on July 12 the *Franconia* started for Genoa, arriving there four days afterward. After divers had examined the wrecked bow the *Franconia* was soon drydocked for reconstruction at the works of the Società Evercizis Barcini. A complete survey showed that the double bottom and the frames to a point above the water line and as far aft as No. 2 bulkhead had been carried away or were badly damaged and the stanchions badly bent. The stem, frames, and stringers round the damaged portion were cut out, and new ones fitted in and securely riveted.

The *Franconia* was launched from the Northumberland yard in February, and has the following principal dimensions: length, 360 feet; beam, 48 feet; depth. 30 feet 10 inches.

DAGNINO ATTILIO.



STEAMER FRANCONIA IN DRY DOCK, SHOWING DAMAGE TO THE FOREBODY.

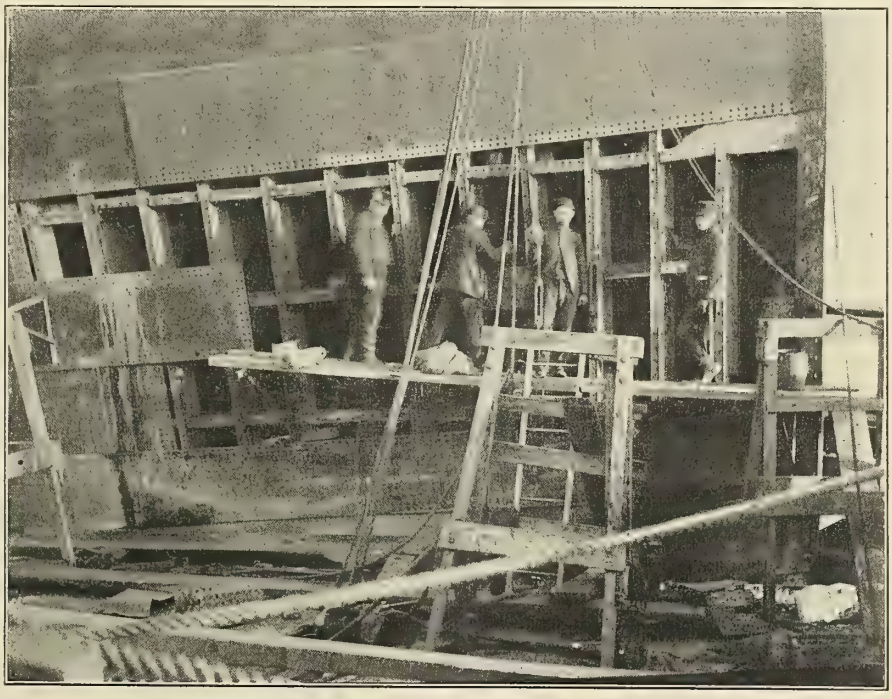
Repairs to the Steamer Denver.

An interesting case, and one showing that the port of New York is equipped with shipyards capable of carrying out quick repair work, is that of the repairs to the steamer *Denver,* of the New York and Texas Steamship Company. This fine steamer, while running on its regular route from New York to Galveston, went into collision with the Norwegian sailing vessel, *Araby Maid,* an iron barque, 194 feet in length and of 873 gross tons, built by R. Steele, of Greenock, Scotland, in the year 1868. The collision took place some thirty-three miles off Tortugas Light, on the southwest coast of Florida, about 8 o'clock at night. The *Araby Maid* was almost cut in two, but fortunately no lives were lost.

Very little apparent damage was done to the *Denver,* which continued its voyage. Upon arrival in New York, investigation showed that many of the bow plates on starboard side in the neighborhood of 10-foot water line,

together with a few frames and stringer angles, had been buckled and dented, so after cargo was discharged the vessel was sent to the yard of the Townsend-Downey Shipbuilding Company, of Shooter Island, N. Y., for necessary repairs.

The work of taking off the plates commenced on Monday morning, March 14, when it was found that fourteen plates (two below the water line) would have to be renewed or faired, two frames cut out and renewed and twelve frames straightened in place, besides sundry stringer angles. To get at the plates below the water line, the vessel was trimmed sufficiently by the stern, by filling the after peak and doublebottom tanks below shaft tunnel with some 89 tons of water. Four of the shell plates affected had to be renewed and the remainder straightened, and, notwithstanding the handicap of one



REPAIRING PLATES ON THE BOW OF THE DENVER.

day of snow, two days of rain and a Sunday, the contractors creditably performed their agreement in having this vessel complete and ready for handing over to the owners by the 23d of March, or 10 calendar days.

The low-pressure slide valve having given trouble for some time, advantage was taken of the laying up of the vessel to draw this valve, when it was found cracked extensively at bottom. Holes were drilled in the vicinity of the cracks and five fine threaded stay bolts were put in and riveted over; over these were put two cast brass patches, each about 18 inches long and 9 or 10 inches wide, one inside and the other outside, securely through bolted and clinched. The valve was then taken to machine and the faces planed, and is to-day as good as new.

The *Denver* was launched in 1901, at the Harlan & Hollingsworth Company, is of the awning-deck type and classed by Lloyd's Register. A description of this ship was given in Marine Engineering, in the issue of September, 1901.

The American Automobile Association Takes Control of Speed-Launch Racing.

One of the most significant steps in the history of American motor-boat sport was taken on Tuesday, April 5, when the American Automobile Association, through its racing board, assumed formal control of the racing of "strictly high-speed motor boats," frequently called automobile boats. This step was taken in response to a very general demand among individual owners of these fast boats, owing to the fact that the measurement rule and time allowance system of the American Power Boat Association, although admitted to be quite satisfactory for ordinary or cruising boats, gives unsatisfactory results when applied to boats of shallow draft and extreme power. The new classification of the A. A. A. was prepared by the technical advisers of the special motor-boat committee, appointed to consider the subject of possible affiliation with the A. P. B. A. These gentlemen, Lieut. Charles H. Hall of the naval militia, and H. L. Towle, reported that the measurement rule referred to credited the fast boats with higher speed than they were able to make, owing, apparently, to the relatively large wetted surface of these boats. They were, therefore, asked to submit a new classification, which was accepted by the racing board. In this classification the time allowance system is discarded, it being considered that too little is known at the present time about the actual speed of high-power boats to justify such a system. In its place is substituted a classification based on the load water line length, with restrictions as to beam and horse power. The latter is calculated solely on the basis of the total piston-head area, on which the actual restriction is laid, and the builder is left free to obtain as high piston speed and as light weight as he can. The most recent constructions

in the way of speed boats seem to indicate that the limits have been placed about as high as possible, and that several seasons may elapse before builders learn to utilize such extreme powers to advantage.

The total classification is as follows:

Class.	Maximum L. W. L.	Minimum W. L. Beam.	Rated H. P.	Piston Head Area, 4-cycle Engine.	P. H. A., 2-cycle Engine.
A.....	26 ft.	3 ft. 9 ins.	30	60 sq. ins.	45 sq. ins.
B.....	32 "	4 " 2 "	50	100 " "	75 " "
C.....	40 "	4 " 9 "	90	180 " "	135 " "
D.....	50 "	5 " 6 "	180	360 " "	270 " "
E.....	65 "	6 " 6 "	400	800 " "	600 " "

In addition there is an "A. A. A. Special" class for boats with hulls not over 40 feet long over all, beam and horse power being unrestricted. This class is designed to bring out a line of boats eligible to compete for the Harmsworth international challenge cup.

A short calculation will show that for a 4-cycle engine the nominal horse power, under the above rating, is based on an assumed M. E. P. of 66 pounds per square inch net, after deducting internal friction, and on a piston speed of 1,000 feet per minute. For the 2-cycle engines the net M. E. P. is assumed to be 44 pounds per square inch and the piston speed 1,000 feet. These figures of M. E. P. and piston speeds are somewhat below what has been found possible in automobile motors, but the piston speed is considerably higher than has been attempted in marine motors until quite recently. Evidently the result of these rules will be to stimulate the development of the high speed and light-weight motor to a point where it will rival the automobile motor. Obviously, unless the engine is not only powerful but very light, it will be impossible to put so large a power into such small boats.

A perusal of the general rules for motor-boat racing, adopted at the same time, shows that it is not the intention of the A. A. A. to enter into a contest with the American Power Boat Association, since it will issue sanctions to any responsible clubs or individuals and will not attempt to prevent those competing under its rules from competing also under the A. P. B. A. rules. It will register and measure any boat on request of the owner and payment of a fee.

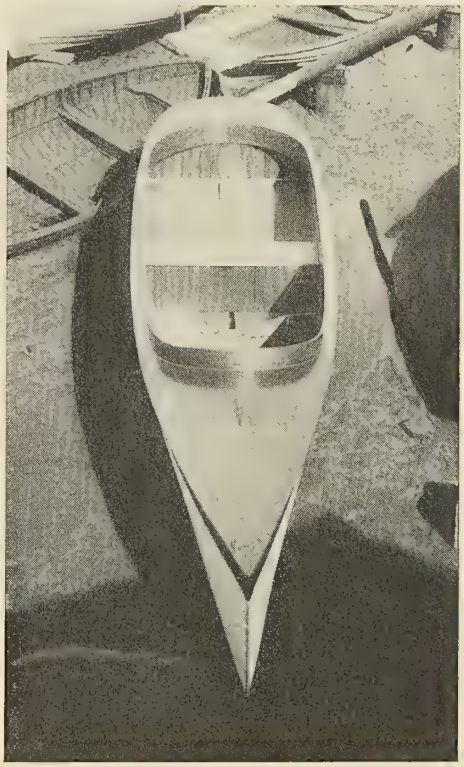
A feature of the hull measurement rule, which is not found in the A. P. B. A. rule, is that boats whose sterns have flattened under sides are measured to the extreme after end of the fair lines of the under body, it being assumed that the stern will settle down to these lines when the boat is under way. The boat may be measured with empty tanks.

The rules for equipment require that every boat shall have a reversing gear and shall carry at least one serviceable anchor weighing 1-2 pound per foot of load water line, and 10 fathoms of manila cable; also one pair of oar locks and oars, and shall be equipped with fog signal and the necessary lights required by law. The boat shall also carry as many life buoys as the total number of persons on board.

The time of the race is to be taken from the limit gun, with no allowance for delay in getting across the starting line. An overtaking boat must allow at least 20 feet of clear water between herself and the overtaken boat. Considering that the speed of these boats will be from 20 to 30 miles an hour, this clearance, which is double that called for by the A. P. B. A. rules, certainly does not seem too much.

Provision is made for challenge races, for which the forfeit fee is $100, to be given, half to the challenged parties and the other half to the A. A. A., in case the challenger fails to appear. Challenge races, like all others, contemplate boat for boat, without time allowance. Another section provides for the making of record and time distance trials under proper safeguards to insure their authenticity.

The motor-boat committee of the A. A. A., by which the foregoing rules were drafted, consists of A. R. Pardington, of the Long Island Automobile Club, Chairman; W. K. Vanderbilt, Jr., and Louis R. Adams, L. I. A. C.

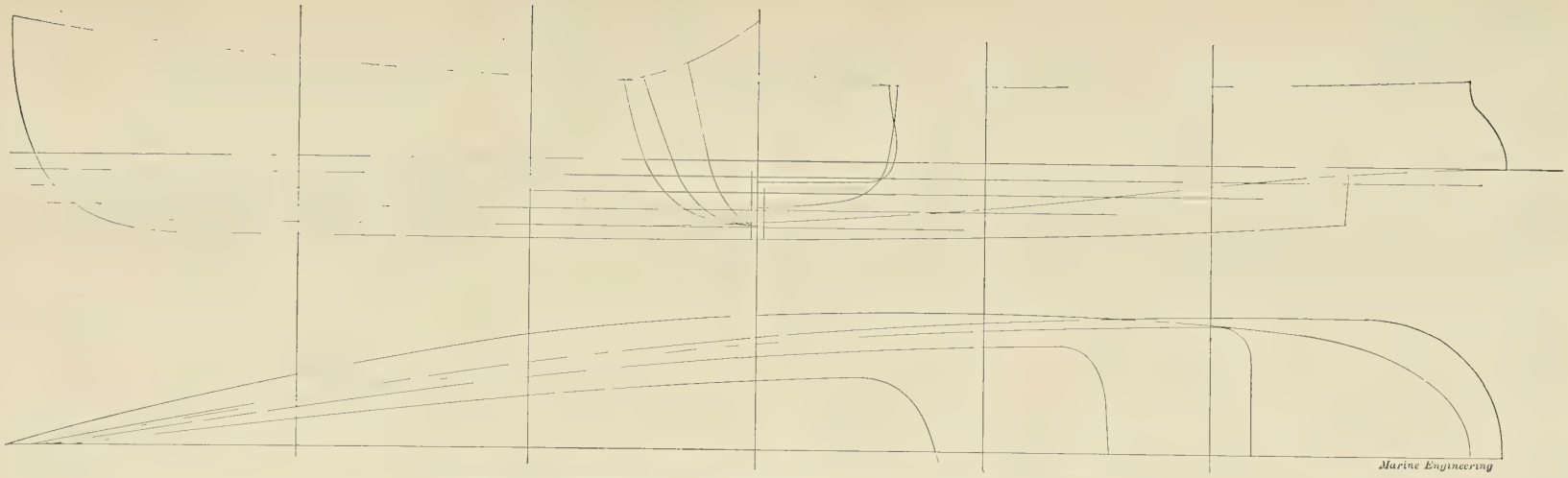


FAST TWENTY-TWO-FOOT MOTOR LAUNCH.

Twenty-two-Foot Launch.

The accompanying water lines and engraving are of a power launch built by the Dutton Engineering Company, Perth Amboy, N. J., for Mr. Warren Cowles, of Peoria, Ill. The launch is 22 feet long over all, 4 feet beam. It was designed primarily as a pleasure boat and incidentally to develop moderately fast speed. The principal novelty is in placing the engine forward of the steersman and in connecting the propeller shaft to the fly wheel end of the engine shaft, so that the steering and engine adjustments are conveniently at hand for the operator when facing the bow. The launch is not intended to carry many passengers and so the lines have been made very fine forward.

As the launch will be used principally on a small



LINES OF 22-FOOT MOTOR LAUNCH BUILT BY THE DUTTON ENGINEERING COMPANY.

western lake, a depth of 36 inches at the bow and 26 inches midships was deemed sufficient for safety. No attempt is made for extreme lightness. The frames are 3-4- by 1-inch oak, steam bent; the planking of solid white cedar 5-8 inch thick; the plank shear, shear strake, and coaming of quartered oak. The deck is laid with white pine in narrow strips, blind nailed. While intended for fresh water the hull is copper fastened throughout and finished in every way as for salt water.

The motor consists of a 2-cylinder, standard Dutton engine developing about 7 horse power at 700 revolutions per minute.

Position of Civil Engineer.—The United States Civil Service Commission announces an examination to be held on June 8, 1904, at the principal cities of the country to secure eligibles from which to make certification to fill the vacancy in the position of civil engineer, Bureau of Forestry, Philippine service, at $2,400 per annum. Full particulars may be had upon applying to the commission at an early date.

Engineering Building.

As a result of Mr. Andrew Carnegie's gift of $1,000,000, to be used in the erection of a suitable building in New York city to contain the libraries, assembly halls, offices, and meeting rooms of the four leading engineering societies, a committee composed of three members of each organization has been appointed to obtain competitive plans and specifications for the new building. The engineering societies are the American Society of Mechanical Engineers, American Institute of Electrical Engineers, the American Institute of Mining Engineers, and the Engineers' Club. The committee has been advised by six architects that they will submit designs in this competition, and it is agreed that the committee will pay to each of these architects the sum of $1,000 as compensation. If one of these six architects be the successful competitor the $1,000 reward paid will be considered as credit on his commission. Plans from other representative architects will also be received and four prizes of $400 each will be awarded for the best designs from these outside architects.

There will be two buildings, one the Engineering Building, with a frontage of 125 feet on the north side of West 39th street and a depth of 98 feet 9 inches, and the other building, the Engineers' Club, on the south side of 40th street, 50 feet frontage by 98 feet 9 inches depth. The backs of the two properties adjoin. The Engineering Building covers, exclusive of the 15 per cent. open space reserved under the city ordnances, about 10,500 square feet. At the top of the building will be three stories (possibly four), presumably similar, to be held for the use of technical, scientific, and engineering societies, who may hereafter be invited to make use of them. Below these will be three floors for the accommodation of the offices and other rooms, exclusive of auditoriums and libraries for the three engineering societies, each of which will reserve a floor for its own uses, and needs at present a minimum space something over 5,000 square feet, to be used for reception room, editorial and counting rooms, secretary's office, office of the staff, etc.

Additional accommodations for the storage of publi-

cations and other documents requires to be a feature of the basement parts of the building. On the top floor or in the roof spaces should be accommodations for the janitor and his family, and a room appropriate for the making of large-scale diagrams, photographic enlargements, and similar work in connection with the illustration of papers for public, scientific meetings.

There shall be provision for a library containing at the outset the combined collections of the three societies, comprising about 50,000 volumes; but accommodations should be made for six or eight times that number of volumes. Besides the open space for reading room and for writing, there must accordingly be space provided for book stacks. The committee will also consider a plan which shall place the library reading room at the top of the building, with a floor below reserved for book stacks.

Below the offices and the library there will be a series of lecture rooms or auditoriums varying in size. The largest, which will have a gallery, should accommodate 1,000 on the floor, and half as many additional in the gallery. Six others, some of which may be in a mezzanine, should vary in size, holding about 400, 250, 200, and 100, more or less, and may well be arranged in pairs with a movable partition between them, so that two may be thrown together on occasion. It may be convenient to have the large room so placed that the lower floor may come nearly on the level with the street. Adjoining the large room should be an adequate assembly and smoking room for informal meeting and conversation. It may, on occasion, be used for collations or dinners, which may be served by caterers from outside.

The floor on the street level should be appropriated mainly to administrative uses. Near the main entrance should be three ample coat rooms aggregating 2,200 square feet, capable of taking care of 1,500 persons at once, and a convenient ladies' dressing room. Near the entrance should also be a bureau of information, in which should be the telegraph and telephone offices, the post office, a sales department for the distributing of the publications of the societies, together with shipping and receiving offices for books, publications, and other packages coming into the building and leaving it.

Ample toilet rooms should be provided on the street level, near the large auditorium, and also in every part of the building.

In the sub-basement or cellar should be put the heating, ventilating, and lighting plant, which would occupy about 3,600 square feet. The boilers will require about 2,000 square feet, the machinery and tanks about 1,600. It is the purpose of the owners to have the auditoriums mechanically ventilated and provision for the ventilating machinery should be ample. Spaces otherwise unavailable in the basement can be valuably used for the storage of transactions, publications, and the like. The basement and sub-basement stories should be about 14 feet high each.

In the auditoriums, at the lecture tables of the important rooms, there should be furnished gas, water, compressed air, and electrical current, and the necessary drainage connections, in order that experiments, illustrations, and demonstrations may conveniently be made in connection with scientific lectures. Sufficient elevator service is to be arranged for.

There is to be convenient communication between the Engineering Building and the Engineer's Club building, about on the level of the first floor and street level, and another by a bridge on the level with the breakfast-room floor.

The above specifications as to the utilization of the various floors and the approximate sizes of the various rooms, may be changed at the option of the competitor, if, in his opinion, it is desirable or necessary to do so, in order to conform to the requirements of his general design.

The Engineers' Club will be eleven stories high with an addition of half a story in the rear for kitchen. In the sub-basement will be the boiler and engine rooms, elevator machinery, etc.; in the basement, the store rooms, barber shop, toilets, etc. On the main floor will be reception room, a large café, an office, coat rooms, telephone booth, etc. The floor above is devoted entirely to a large club room and a library. On the third floor most of the space is to be taken up by a billiard room, and the remaining by committee rooms and a card room. Six floors above will be arranged with about ten bed rooms on a floor, single and in suit, with baths, for the accommodation of members. One floor will be devoted to a breakfast room, another to a dining room, while on the roof will be the kitchen, store rooms, attendants' quarters, etc. Two passenger elevators run from the basement to the eleventh floor.

The secretary of the committee is Professor F. R. Hutton, 12 West 31st street, New York, N. Y.

LAUNCHES.

Steel Freighter R. W. England.—On May 6 the freight steamer *R. W. England* was successfully launched at the yards of the Great Lakes Engineering Company, at Detroit, Mich. This is the first steamer to be launched by this company. The *England's* dimensions are: length over all, 378 feet; beam, 50 feet; depth, 28 feet. She will have a carrying capacity of 5,700 tons of iron ore, or 6,000 tons of coal, and can store about 200,000 bushels of grain in her hold.

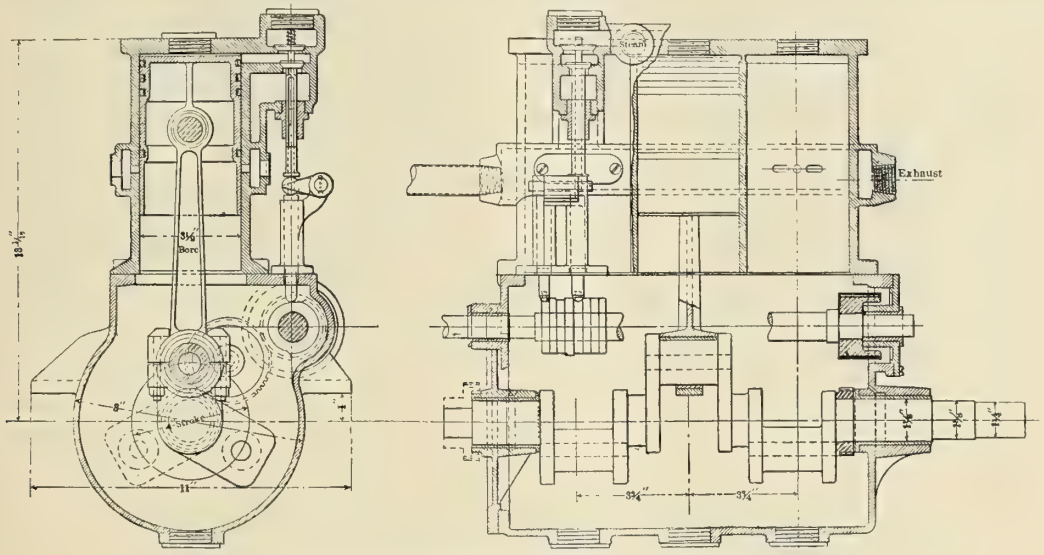
Steamer Sahara.—On May 5 the second largest carrier on the Great Lakes was launched by the American Shipbuilding Company from the Lorain yard, for Mr. G. A. Tomlinson, of Duluth. The ship is 494 feet over all, 474 feet on the keel, 52 feet beam, 29 feet deep, with a 5-foot water bottom. Arched girder plates, running athwartship between the hatches to web frames, are substituted for stanchions. The triple expansion engine has cylinders 22 1-2, 36, and 60 inches diameter by 42 inches stroke, and is supplied by steam from two Scotch boilers, 13 feet 9 inches diameter by 11 feet 6 inches, equipped with Ellis & Eaves draft. The keel of the *Sahara* was laid on March 1.

Armored Cruiser California.—On April 28 the United States armored cruiser *California*, building at the Union Iron Works, San Francisco, was successfully launched. A few particulars of this launching will be given in next month's issue.

ENGINEERING SPECIALTIES.

Three-Cylinder Steam Engine.

A new three-cylinder, single-acting steam engine, for automobile, launch, and stationary use, where high speed and light weight are desired, has recently been placed on the market by the Dieter Steam Engine Company, 113 Liberty street, New York, N. Y. The intention of the designers was to produce an engine of simple construction, where the valve setting would not require fine adjustment, and in which worn parts are accessible and may be readily taken out.



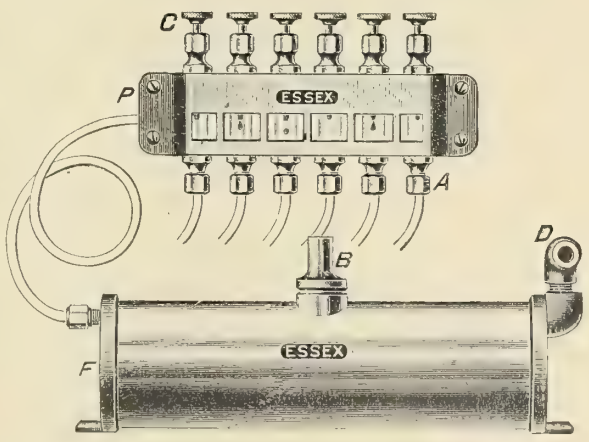
THE DIETER THREE-CYLINDER HIGH-SPEED STEAM ENGINE.

Referring to the illustration, it will be seen that the three cylinders and their respective valves are in one casting and mounted on top of the crank case. A cam shaft runs above and parallel to the main shaft and is driven by gearing from the latter. Poppet valves are used, one for the steam and one for the exhaust, the latter set on a sleeve of the steam-valve stem. Each is operated by its own cam lever. The cam shaft has a certain amount of end movement by means of which any one of four cams may be brought opposite each cam lever, thereby giving three different points of cut-off for ahead and one for stern motion. The valves open wide at the admission of steam and remain so until the cut-off takes place, thus preventing wire drawing. The clearances are very small, thus reducing steam consumption. The engine is run at a high speed and has shown large power per unit of space by working tests.

The exhaust chamber runs along the front of the engine at a height above the middle of the cylinder and is so arranged that it will serve as a muffler and will not permit of clogging of the parts from condensation. Steam and exhaust ports are adjacent to each other and communicate with the cylinder through a common passage and the valves do not require packing against the boiler pressure. No lubrication of the valves is necessary, while the cylinders are oiled automatically from the crank pits, thus doing away with the necessity of using oil cups.

Automatic Multifeed Oiler.

The illustration below shows the Essex automatic multifeed oiler for hydrocarbon engines. One of the troubles experienced with such engines is that of securing a positive and regular supply of oil to the various moving parts. The type of oiler here illustrated is made with any number of feeds and with any size reservoir, which is shown at the bottom of the engraving. Each connection at *A* leads to one bearing and the flow of oil through each pipe may be accurately adjusted by means of the valves *C* and the sight glasses. When once adjusted all the attention necessary is to fill the reservoir with oil occasionally. *B* is a filler plug in the reservoir, *D* is the point where connection is made to the crank so as to obtain the pressure for operating lubricator to supply oil to the distributor.



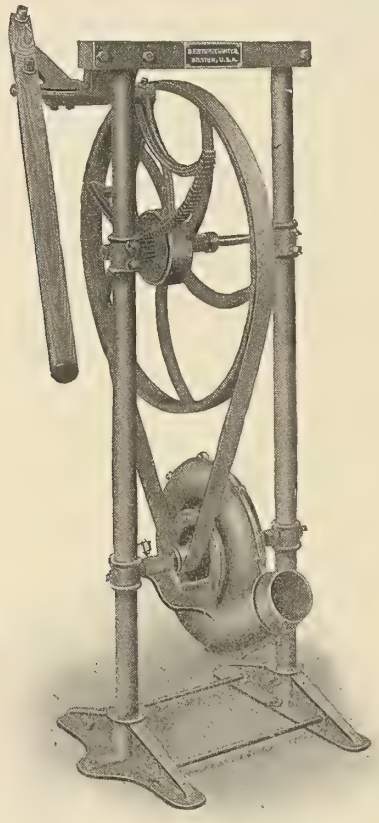
CONTINUOUS-FEED MULTIPLE OILER.

The manufacturer, the G. B. Essex Brass Company, 480 Franklin street, Detroit, Mich., also make a complete line of cylinder lubrication and grease cups for marine and gasoline engines.

Improved Hand Blower.

Hand blowers have been extensively introduced in connection with forges of all kinds, from the old-style brick to the modern iron forge, as they are efficient and economical substitutes for bellows. Another use of the forge is for portable ventilating apparatus. The design here illustrated is simple, strong, rigid, and compact, and is claimed to be economical in operation and readily portable. The running gear is simple and strong.

The blower is adjustable on the shaft and its outlet may thus be set to discharge in any direction and readily connected to the forge tuyere by means of galvanized

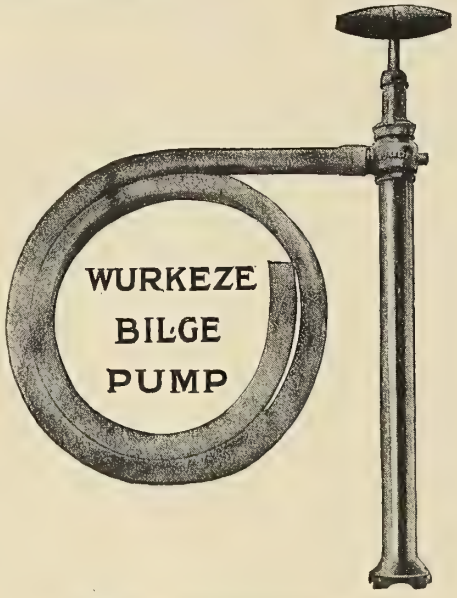


PORTABLE HAND BLOWER.

iron piping. The blower is of cast iron strongly constructed in every particular, has a steel shaft running in babbitted boxes, and a fan wheel of galvanized steel solidly riveted to a composition hub with extending arms. The frame is carefully designed, well braced, and is so arranged that the slackness of the belt driving the blower may be taken up by lowering the blower shaft, which is supported by collars sliding on the frame. The feet are provided with holes so that the hand blower may be readily screwed to the floor.

These hand blowers are made by the B. F. Sturtevant Company, Boston, Mass., in all sizes. The total length on the floor of Style B-1 is 18 inches, while the total height of the frame, not including the handle, is 48 inches. The driving wheel is 24 inches in diameter, the blower outlet is 3 1-2 inches in diameter, and the complete outfit weighs but 135 pounds.

Style B-2 is of slightly larger dimensions and has proportionately greater capacity for delivering air. The driving wheel is 24 inches in diameter, the blower outlet is 4 3-4 inches in diameter, and the complete outfit weighs 155 pounds.



BILGE PUMP SUITABLE FOR SMALL BOATS.

Portable Bilge Pump.

A small, handy bilge pump has recently been placed on the market by the Marine Hardware Company, Peabody, Mass., designed specially for launch and small yacht owners. It is made of brass throughout and so cannot rust. It is easy to operate and not liable to break down, as the mechanism is strong and very simple. The pump is made in two sizes, with a capacity of 6 or 12 gallons.

James Watt Memorial.

The following letter is being sent to the American engineers in behalf of a memorial to James Watt:

"A memorial statue is about to be erected in Greenock, Scotland, on the site of the humble cottage in which James Watt was born. For this purpose subscriptions of small amounts are being solicited in many countries, as it is felt that the memorial should represent the contributions of the thousands who know and appreciate what the invention of the steam engine has meant to the material progress of the world.

"Should you desire to associate yourself with this movement, kindly send any number of dollars, not exceeding five, and accompany the contribution with your autograph on the enclosed slip. The latter is desired for transmission to Greenock, to show the number of the American contributions.

"Our country has, probably, been the greatest beneficiary of Watt's labors, and the committee hopes that the response from the United States will exceed that of any other country in point of numbers, as the number of subscribers is a greater tribute than the amount subscribed. The committee is composed of the presidents of the American engineering societies.

"ANDREW CARNEGIE, Chairman."

QUERIES AND ANSWERS.

Q. 197.—Please answer through your Q. and A. column if there is any rule for the staying power of plain rolled tubes.

The boilers of S. S. *Sprague*, for instance, in your September number. Head's stayed top and bottom depending on the tubes in centre. Scotch boiler they are stay tubes put in by this rule if not mistaken allowing for the bore of tube that is not exposed to boiler pressure.

$$\frac{C \times (\text{thickness in 1-16 inch})^2}{\text{Boiler pressure}} = \sqrt{\text{Area}} = \text{Pitch.}$$

Also how do you get the strength necessary to resist collapsing pressure on the circular bottom of a combustion chamber box Scotch boiler? T. R.

A.—The formula above quoted equals *area* and not square root of area, and pitch. There is no satisfactory formula for the staying power of a plain rolled tube. Where stay tubes are fitted they may be spaced and fitted in accordance with the following formula:

$$\frac{200 \times (t-1)^2}{p} = A.$$

Where t = thickness in 16ths.
p = pressure allowed.
A = area supported by one stay tube, or,
A = product of the two pitches at which stay tubes are placed.

Thus, for example, $p = 160$, $t = 3\text{-}4$ inch.
Then $t = 12\text{-}16$ and we have:

$$A = \frac{200 \times (12-1)^2}{160} = 151.$$

This would correspond to a spacing of about 12 by 12, or 12 by 12 1-2 inches, for the stay tubes.

For the strength necessary to resist collapsing pressure on the circular bottom of the combustion chamber of a Scotch boiler the following formula may be used:

$$p = \frac{700\, t^2}{D\, h}.$$

Where t = thickness of plate in sixteenths.
D = diameter of circle to which plates are curved.
h = spacing of angle iron stiffeners.

In order that this formula may apply, the plate must be stiffened with angle iron stiffeners securely riveted to the plate, and with leaf of angle iron at least .8 that of plate and height at least one-half the pitch of stiffeners. With this form and proportion of stiffener the relation between the thickness of plate, the steam pressure and pitch of stiffeners may be worked out by the formula given above.

Thus, for example:

$t = 9\text{-}16$ inch.
$h = 6\ 1\text{-}2$ "
$D = 44$ "

Then $p = \frac{700 \times 81}{44 \times 6.5} = 198$ pounds.

Q. 203.—Will you please inform me as to how I can figure out the capacity in gallons of a centrifugal pump? I have one connected to bilge, and wish to find its capacity in gallons per minute, but no one out here seems to know how to get it, although I have made several inquiries. If you can enlighten me I will appreciate it. C. F. B.

A.—There is no simple formula including the various items involved in the operation of a centrifugal pump and giving the capacity which may be expected. The delivery of such a pump will depend on the diameter and revolutions of runner, on the size of discharge pipe, on the total head from supply level to discharge level, and on the character of the discharge piping as regards turns and bends, and whether there is a single lead or multiple lead as in a surface condenser.

Builders of the usual type of centrifugal pump usually plan on a velocity through the main pump discharge of 500 to 600 feet per minute on the average. If this velocity is realized then the capacity in cubic feet per minute is found by simply multiplying the area of the discharge pipe in square inches by this figure and dividing by 144. Thus, a 10-inch discharge with a velocity of 600 feet, would correspond to a delivery of $600 \times 78.54 \div 144 = 327.24$ cubic feet per minute = 2,446 gallons.

The next point is the velocity of runner necessary to realize this velocity and therefore the corresponding capacity. This is usually reckoned as the linear or running speed of the tips of the vanes, and should be about 500 times the square root of the total head in feet. This total head is the difference in level between supply and discharge, including suction and delivery heads, with added allowance for friction; and it is in estimating the latter item that judgment is required. Thus, in illustration: if the difference in level between supply and discharge is 12 feet and we add 4 feet as the equivalent of the frictional resistance, then the total head will be 16 feet, and the runner speed should be about $500 \times \sqrt{16} = 2{,}000$ feet per minute. With a runner 30 inches in diameter this would mean revolutions of about 250 per minute. The discharge capacity of the pump is of course under control by means of the revolutions, and in the case above cited if the full capacity is not realized with the revolutions given the number must be increased until the proper capacity is reached.

Q. 210.—We have a compound engine with cylinders 4 and 7 inches by 6 inches installed in a launch 36 feet long by 6 1-2 feet beam. The engine runs non-condensing at 350 revolutions per minute and turns a wheel 26 inches diameter and 48 inches pitch, driving the boat at about 12 miles.

This engine we are wishing to change to a triple with a low-pressure cylinder 13 inches diameter, and place it in a boat of good lines 50 feet long by 9 feet beam. We propose to install a new boiler which will supply steam at 220 pounds pressure at the boiler, and to run the engine condensing at about 25 inches vacuum. The high- and intermediate-pressure cylinders will have piston valves, the low will have slide valve, and the cranks will be set at 120 degrees. It is expected that 500 revolutions will be attained. Will you please tell us what power should be indicated in the remodeled engine, and if there is any reason why this outfit should not come up to expectations?

A.—The combination of a 13-inch l. p. cylinder with your 4- and 7-inch cylinders for h. p. and i. p., would hardly make a well-proportioned triple-expansion engine. The area ratio between the l. p. and h. p. would be $(13)^2 \div (4)^2 = 169 \div 16 = 10.6$, which is rather excessive for standard marine practice. A better proportion would be given by a 12-inch l. p. This would give an area ratio between the l. p. and h. p. of $(12)^2 \div (4)^2 = 144 \div 16 = 9$. This is well on the high side of marine practice, but results from fitting a low-pressure cylinder somewhere nearly in suitable ratio to the high and intermediate which are already fixed. With such an engine and a rather late cut-off in the h. p. cylinder, say 3-4, you should get a total expansion ratio of about

12, and with 220 pounds steam and 500 r. p. m. should develop about 60 I. H. P.

It is doubtful if you would get very much more than this with a 13-inch l. p. cylinder. It is true that the cylinder would be larger and the steam would be expanded further, but the mean effective pressure would be less and the gain would be very small. We must remember that primarily the power developed will depend on the main factors—amount of steam entering the engine and the extent to which it is expanded. In the cases we are considering the amount of steam entering would be the same in either case, and the only difference would be that due to the expansion with a 13-inch as compared with a 12-inch l. p. cylinder. This would be too small to be of practical value, and, in fact, would be in some part at least offset by an increased loss due to cylinder condensation.

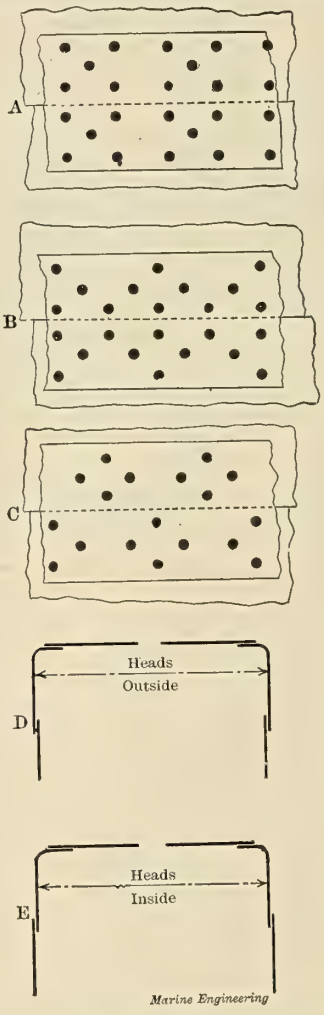
A still nearer approach to standard practice as regards the total number of expansions suitable for small engines such as the one here considered, would be realized with a 10.5- or 11-inch l. p. cylinder, giving with suitable cut-off in the h. p. from 10 to 12 total expansions and about the same power as above. This, however, would not give quite as suitable a proportion for the intermediate as the 12-inch l. p., although the 11-inch l. p. would give a fair proportion and might, on the whole, be the best value, having in view the general combination.

Your propeller for this engine will naturally have to be of a size and general design entirely different from that on your old boat, and adapted to the speed and other conditions which you expect to realize with your new outfit.

Q. 211.—Will you please advise which riveted butt strap is the stronger, *A* or *B*? The same conditions exist in both cases as regards diameter of rivets, thickness of butt strap, size of boiler, etc. Also please decide which is the correct position to place a head in the steam space of a boiler as per sketch *D* or *E*.

A.—If it is to be understood that in joint *A* the rivets are equally spaced in the inner and outer rows on either side the center line, while they are double spaced in the middle row on each side, then such a form of joint can hardly be considered as a representative or desirable form of fastening for riveted work. It is certainly not a common form of joint for boiler fastening. If, however, you had in mind a joint of the type shown in *C*, which is frequently met with in marine-boiler construction, then as between joints *B* and *C* it may be said that, with proper proportions between thickness of plates, diameter of rivets, and spacing or pitch, each joint may be made thoroughly satisfactory and efficient and there is but little to choose between them on the score of efficiency. For the same strength, however, joint *C* will require fewer rivets and hence less drilling and riveting, and hence less expense in construction. On the other hand joint *B* is rather more easily made steam tight and maintained in such condition. It will be noted that joint *B* consists of a regular double-riveted staggered joint with an additional outside row at double spacing. This makes good steam-tight work and is sometimes preferred on this account, notwithstanding the somewhat greater cost.

Regarding the preferable way of placing the heads in a boiler as shown by your sketches *D* and *E*, this is largely a matter of opinion. Method *E* is, on the whole, more commonly employed, presumably because it gives a little more space between the back head and combustion chamber, and because it places the lap of the two head plates in better relation to lodgment of scale, etc., than



with method *D*. Both methods, however, are employed, and presumably with but small difference in general applicability.

Q. 212.—Which do you consider the better crank arrangement for a two-cylinder, four-cycle gasoline marine motor, with cranks 180 degrees apart of both together, giving an impulse at each successive revolution?

What is the best method of balancing the pistons in the latter case? Can you give any rule or formula for doing so?

What is a good method for determining fly-wheel diameter and proportions, or inertia?

A.—With a two-cylinder, four-cycle motor, cranks at 180 degrees, two impulses are received in four strokes, the impulses coming in pairs with a pair of non-impulse strokes between. Thus, if we call the strokes of one of the motors 1, 2, 3, 4, 5, 6, etc., then the shaft will receive an impulse on strokes 1, 2—5, 6—9, 10, etc., while there will be no impulse on the intermediate strokes 3, 4—7, 8—11, 12, etc. With the same motor and cranks together the shaft will receive an impulse on strokes 1, 3, 5, 7, etc., while there will be no impulse on strokes 2, 4, 6, 8, 10, etc. It thus appears that the first arrangement will give a double impulse for one revolution and no impulse for the next, and so on, while the second arrangement will give a single impulse for each revolution. The latter arrangement will therefore give a

somewhat more even distribution of turning effort and will conduce to steadier running with the same size of fly wheel, or will admit the use of a somewhat smaller wheel with an allowable range of speed fluctuation. To set over against these results, which are useful so far as they go, we have the decidedly unbalanced condition of the moving parts which naturally results from this combination. A double engine with cranks together has exactly the same lack of balance which the single engine has, while with cranks opposite, the moving parts are balanced completely as regards the so-called primary inertia forces. There remain, it is true, the secondary inertia forces, but these cannot in any event be balanced without the use of additional sets of moving parts and the introduction of features of arrangement not desirable in gas-engine operation. The two-cylinder engine with cranks opposite is therefore as well balanced as it is practicable to make an engine of this type, and this fact has led to the general use of opposite cranks in such engines.

With regard to the problem of balance for the engine with cranks together, it should be first remembered that it is not alone the pistons which require counterbalance, but the connecting rods and cranks as well. If these are to be counterbalanced it must be by the use of a rotary weight in the shaft located opposite to the crank—the usual form of shaft counterbalance. The amount of this counterbalance may be obtained by the following rule:

(1) Find the weights of all the moving parts except the crank shaft.

(2) Add together the weights of piston and connecting rod and multiply the sum by the crank throw or half stroke.

(3) Find by computation or otherwise the weights of two crank throws and a crank pin and add.

(4) Estimate the distance from the shaft center to the center of gravity of the crank comprising the two throws and the pin, and multiply the total weight in (3) by this distance. This gives the moment of the crank about the shaft center.

(5) Add the results in (2) and (4) and the sum will be the total moment for the shaft counterbalance. This total amount may then be divided in any convenient proportion between weight and arm. Thus a moderate weight with a considerable arm may be fitted, or a greater weight with a smaller arm. It is only necessary that the weight fitted multiplied by the distance of its center of gravity from the shaft center equal the sum of the results found in (2) and (4).

This will give the counterbalance for one engine; the same must, of course, be fitted for each.

For the size of fly wheel the following approximate formula may be employed:

$$W = \frac{200{,}000{,}000\ n\ H.\ P.}{R^3\ D^2\ c},$$

where n is the greatest number of strokes which the engine is expected to run without an impulse, and usually taken as 7 to allow for a miss in the ignition.

$H.\ P.$ is the horse power developed.

R is the revolutions per minute.

D is the diameter of the wheel in feet.

c is the fraction of fluctuation to be allowed in the speed of the engine.

W is weight of fly wheel rim in pounds.

For safety the relation between R and D should be such that the rim velocity will not exceed 100 feet per second.

Thus, for example, suppose $n = 7$, $H.\ P. = 10$, $R = 500$, $D = 2$, $c = .05$. Then we have:

$$W = \frac{200{,}000{,}000 \times 7 \times 10}{125{,}000{,}000 \times 4 \times .05} = 560 \text{ pounds.}$$

Q. 213.—(*a*) I wish to know the proper size for an air compressor to deliver 4 cubic inches of air each stroke at 40 pounds pressure, the compressor to make five hundred strokes per minute.

(*b*) My present pump is 2 inches diameter by 2 inches stroke, and I can only maintain ten pounds pressure. The inlet discharge valves are 1-2 inches diameter. Please tell me what is the matter.

A.—(*a*) This is a very high speed at which to run an air compressor of ordinary type, for it scarcely gives time for the valves to act. To find the size of cylinder, however, to compress air to 4 cubic inches at 40 pounds pressure, we use the following formula:

$$v_0 = \frac{p_1}{p_0} v_1,$$

where p_0 and v_0 are the pressure and volume at the beginning of compression and p_1 and v_1 the pressure and volume at the end of compression.

In compressing air, corrections must be made for the increased pressure due to increased temperature. Therefore, this formula can only be used if the air is cooled by water jacket. It is impossible to actually keep down the temperature of the air during compression to that of the air as it is admitted, but for simplicity's sake we take the formula as it stands. The pressures taken must be absolute pressure. In this case we compress to 40 pounds. Therefore,

p_0 = atmospheric pressure, or, 14.7 pounds.
$p_1 = 40 + 14.7 = 54.7$.
$v_1 = 4$ cubic inches.

Therefore, we have for the cylinder displacement,

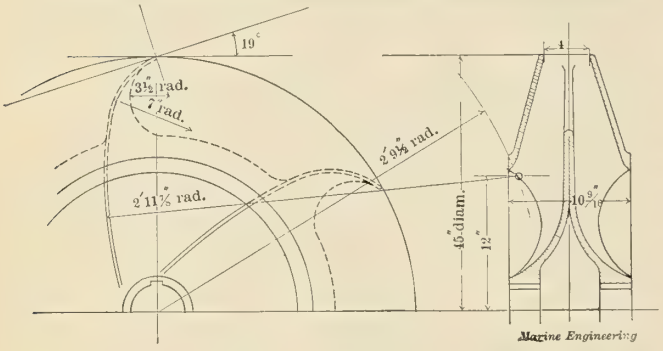
$$v_0 = \frac{54.7}{14.7} \times 4 = 14.7.$$

To allow for leakage, etc., this volume for the air compressor cylinder should be increased say to 18 cubic inches. There are several sizes of cylinders that would comply to this requirment, such as one 2 inches stroke, 3 3-8 inches diameter; or one 4 inches stroke, 2 7-16 inches diameter. In place of having such a small cylinder and high number of strokes, would suggest that you cut the strokes in half and double the cubical contents of your cylinder.

(*b*) By the same process as above you will find that to compress 4 cubic inches of air to 10 pounds pressure requires a cylinder of about 6.7 cubic inches capacity, which is about the size of your cylinder, and therefore there is nothing specially the matter with the pump except that it is too small to do the work.

Q. 214.—It is indeed gratifying to get some exact data on centrifugal pumps, such as given by Mr. P. P. Bird in his article in your March issue. I would like to find out, if possible, what in this pump is the angle of relative discharge from the fan, to a tangent to the periphery of the fan, as this is an important factor in determining peripheral velocity. H. D. B.

A.—The angle asked for is as shown in the cut to be about 19 degrees, where is also given a diagram of the method of laying out the runner for this special pump. You will note in the section at the right hand that the



discharge at the periphery is contracted, which is done in order to make the speed of the water more uniform throughout its passage from hub to circumference.

Q. 215.—Will you please let me know through your Query and Answer column how to figure the efficiency of a boiler for a pipe system and an engine, and the efficiency of the arrangement as a whole? Also, how to figure the thermal efficiency of the above separately and collectively? A CONSTANT READER.

A.—The term "efficiency of a steam plant" may be interpreted to mean almost anything. In the first place, there are the efficiencies of the furnace and heating surface of the boiler, efficiency of the piping, the thermal efficiency of the engine, and mechanical efficiency. The subject is one too large for these columns, and we refer you to any of the standard steam-engineering books on this subject.

Let us assume a small modern plant showing average good results, and consider the *thermal* efficiency.

Under the best conditions on recorded tests, 13 pounds and over of water have been evaporated per hour from and at 212 degrees, per pound of coal containing 14,000 British thermal units. The heat in the coal is, of course, the figure used in basing thermal efficiency in this query. An evaporation of 10 pounds is very good; let us assume that in our plant 9 pounds of water are evaporated per hour per pound of coal.

The heat required to evaporate one pound of water from and at 212 degrees is 966 B. T. U. nearly. Therefore, 9 pounds of water evaporated will represent 8,694 B. T. U.; therefore, the efficiency is $\frac{8,694}{14,000} = 62.1$ per cent.

The radiation in piping would depend whether or not the pipe is covered with non-conducting material, kind and thickness of material, and the length of steam lines. Under good conditions there should not be a loss of over 2 per cent., *i.e.*, the efficiency would be 98 per cent.

A multiple-expansion engine should indicate a horse power on from 12 to 25 pounds of steam per hour. Some very low figures have been recorded, but 18 pounds is very good practice. The heat required to evaporate 18 pounds of water per hour, from and at 212 degrees, into steam $= 18 \times 966 = 17,388$ B. T. U. Now, the mechanical equivalent of heat is the number of foot pounds required to raise one pound of water one degree Fahrenheit, and, by experiment, this is found to be 778 foot pounds.

Therefore, I. H. P. $= \frac{33,000}{778} = 42.4$ B. T. U. per minute $= 2,545$ B. T. U. per hour. Now, for our engine, the thermal efficiency will be $\frac{2,545}{17,388} = 14.6$ per cent.

With these efficiencies, the efficiency of the plant will be $62.2 \times 98 \times 14.6 = 8.9$ per cent.

Q. 217.—Does the time served on board a United States naval vessel by a machinist in the steam-engineering department count for a similar period of time served in the engine room of a sea-going ship in applying for an engineer's license from the United States Steamboat Inspection Service? Also, can a machinist after one year at sea on a ship of our government make application for engineer's license? M. B. R.

A.—We would refer you to page 65 of the General Rules and Regulations prescribed by the Board of Supervising Inspectors of Steamboats, a copy of which may be obtained by applying to the board, Department of Commerce and Labor, Washington, D. C.

We are advised by the supervising inspector of the second district that the service of machinist would meet the requirements of the rules and regulations, provided such service was had in the engineer's department of the steam vessel when she was in commission; and that the applicant may apply after having one year's service in said department, provided he is a regular machinist by trade.

Q. 219.—Will you please inform me whether there are any schools in the United States teaching marine engineering, or any ships in the merchant or naval service that receive cadets for teaching this branch? I am about to graduate from high school and would like to take up a course.

A.—There are several schools of marine engineering and naval architecture at many of the colleges. Prominent among these is the school of marine engineering, Cornell University, Ithaca, N. Y.; Boston Institute of Technology, Boston, Mass. Webb's Academy, Fordham Heights, New York, gives instruction in these courses. The courses in the colleges are generally more advanced and are taken up in the junior and senior years. Two of the correspondence schools also have to offer courses in these subjects. You may obtain full particulars by applying to the registrars of the colleges and schools.

EDITOR, MARINE ENGINEERING:

In the March issue of your instructive paper, in answer to query No. 195, you state that there is no direct gain, in terms of heat, in using a heater provided with steam direct from the boiler. Permit me to state that after an extensive experience of live steam feed water heaters, I have never failed to find that the use of same resulted in the economizing of fuel and the reducing of the boiler repair bills.

I have on one of the vessels under my supervision a live steam feed water heater, which puts the water into the two Scotch boilers at a temperature of 350 degrees Fahrenheit, with steam at 160 pounds above the atmosphere. The chief engineer of this vessel reports a gain of about 8 per cent. in fuel economy. In the opinion of the writer, this is entirely due to the improved conditions brought about inside the boilers by the using of the high-temperature feed, thus causing the circulation of the water in the boilers to be greatly accelerated. Possibly one might not call this a direct gain, but that it is a gain there is no doubt. The raising of the feed water to some 200 degrees Fahrenheit by means of an exhaust heater, while excellent in itself, does not go far enough. D. B. CUMMING.

TECHNICAL PUBLICATIONS.

The Lay-out of Corliss Valve Gears. By Sanford A. Moss. Van Nostrand's Science Series, No. 119. Size 3 1-2 by 6 inches. Pp. 108, with diagrams and 3 folding plates. New York: D. Van Nostrand Company. Price 50 cents.

This discussion of the Corliss valve gear has been prepared by the author in order to fill what has been a clearly evident lack in the technical literature of the day. Widely used as the Corliss valve-gear mechanism is, it does not seem to have been adequately treated from a theoretical and fundamental point of view; from such a point of view as is needful for thoroughly intelligent and resourceful design. A complete discussion is given of the theoretical principles underlying the kinematic design or lay out of a gear with single eccentric, and this is followed by plain directions for making the lay out on the drawing board. The methods herein given should possess a pronounced advantage over the empirical and thumb rules so commonly used hitherto, the latter giving thoroughly reliable results only when in the hands of designers of considerable experience.

A briefer discussion is also given of the gear with double wrist plate and long range of cut off, although the complete kinematic theory of this gear is not developed.

The work is divided into eight chapters, dealing with a description of the ordinary Corliss valve-gear mechanism and its operation, with the influence of angular advance, with the relative motions of eccentric wrist plate and valves, with the theory of the Corliss wrist plate, with valve displacement curves, with the selection of the arbitrary dimensions of a Corliss gear, and with the layout of a single wrist-plate gear as a drawing-board problem.

The treatment throughout is clear and should be readily followed by all who are likely to be concerned in work of this character. The discussion in Chapter VII. of the selection of the arbitrary dimensions of a gear is especially timely, pointing out as it does the large number of variables and the innumerable ways in which these may be selected without apparent material effect on the results to be obtained. These various items are discussed and their influences are pointed out, and practical suggestions are given for their determination in such way as to relieve the problem of ambiguity, and to insure such arrangements and proportions as are warranted by the best practical experience.

The work is cordially recommended to all who may be concerned with the special problems which arise in connection with the design of valve gears of this type.

Bevel-Gear Tables.—A collection of tables and necessary explanation to enable anyone to figure bevel gears without the use of trigonometry. By D. Ag. Engstrom. New York: Locomotive Publishing Company. Price $1.

This is another of the Derry-Collard manuals; clear, practical, and to the point. While it is true that few engineers are now called on to determine the details of bevel-gear design, such items being now more commonly bought from the maker like so many yards of cloth from the merchant, yet occasions may arise when such work must be done, and this little book would then be hailed with satisfaction as the means of saving much tedious computation.

The tables are preceded by a description of the various elements of a bevel gear and of their relations to each other. These are followed by a series of tables covering all possible combinations of gears from 12 to 47 teeth, and readily adapted to any pitch by a mere operation of division. With these tables in hand it is only necessary to know the pitch at the outer diameter, the face, and the number of teeth. All other elements are then directly determined from the tables and without the trigonometric computations which would otherwise be required. This little book should find a welcome place in the library of every designer who is liable to be called on to deal with bevel gears.

SELECTED MARINE PATENTS.

755,728. WAVE MOTOR. DAVID G. WEEMS, BONANZA, COLO. Two claims.

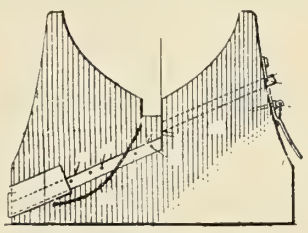
756,030. SUBMARINE BOAT. SIMON LAKE, BRIDGEPORT, CONN. One claim.

756,031. SELF-CLEARING PROPELLER. CHARLES H. LEE, SOUTHAMPTON, N. Y. One claim.

756,244. GLASS-BOTTOM BOAT. LOUIS LARSON, MUSKEGON, MICH. Nine claims.

Claim.—1. A boat having its bottom provided with a glass plate, an inclosure over said plate, and a mirror at the top of the enclosure.

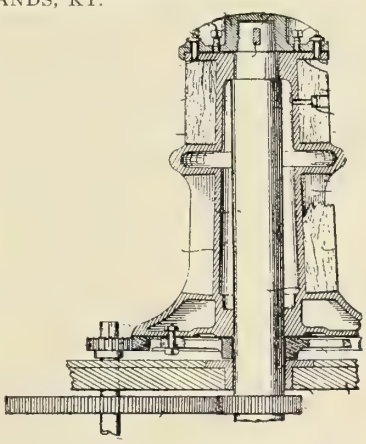
756,661. BOAT CHOCK. IRVING A. LEMM, VICTORIA, CANADA. Filed December 11, 1903. Serial No. 184,805. (No model).



Claim.—1. In a chock or rest for a ship's boat; the construction of the same in two parts having the line of junction from the inboard side of the keel recess in the chock, and extending therefrom to the outboard side of the chock, means for supporting the movable portion against lateral displacement, and means for securing the removable portion to the fixed portion of the chock and for releasing the same from the inboard side of the chock. Two claims.

756,833. WAVE MOTOR. MELVIN D. COMPTON, NEW YORK, N. Y. Seven claims.

756,851. CAPSTAN. GOTTLIEB HARTWEG, DISTRICT OF HIGHLANDS, KY.

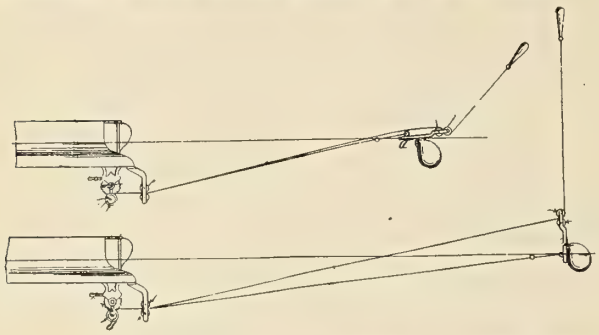


Claim.—1. In a capstan, the combination of an iron barrel, a capstan head, a supporting spindle and wooden whelps carried on the iron barrel arranged with spaces between them and projecting above the face of the barrel. Ten claims.

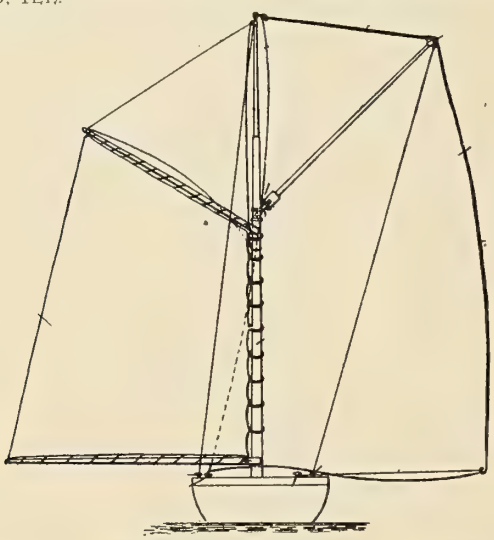
756,887. SOUNDING APPARATUS. JOHN PHILP, NEW YORK, N. Y.

Claim.—1. In sounding apparatus, the combination of a float-anchor secured to a line attached to a reel, said reel, a sounding weight attached to a line passing over a roller or other bearing upon the said anchor float and secured to a reel, said reel, and means for operating said reels for the purpose. Fifteen claims.

757,385. MEANS FOR RETARDING AND STEERING VESSELS. AARON ZERBE, ZERBE, PA. Four claims.

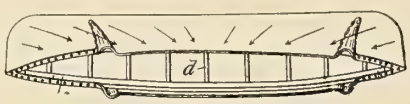


757,474. SPINNAKER SAIL. GEORGE A. LOWRY, CHICAGO, ILL.



Claim.—1. The combination with a mast of a spinnaker sprit or boom connected to the mast near its top or head, and a spinnaker sail having its upper outer corner connected to said boom, and a sheet connected to the upper inner corner of said sail and leading to the mast at a point above said sprit or boom. Nine claims.

757,832. BOAT. JOHN C. NICHOL, MONTREAL, CANADA.



Claim.—1. In the manufacture of a boat first saturating a single sheet of heavy-felted fabric with a resinous substance, then applying said sheet to a mold or pattern which contains a separable keel, then attaching the ends of said blank to the ends of said mold, then smoothing said blank upon the mold from the ends toward midships and attaching the edge of the blank to the mold as the smoothing progresses, then drying said fabric, and finally removing it from the mold. Two claims.

757,858. APPARATUS FOR SCRAPING ORE FROM WINGS OF VESSELS. MATTHEW ANDREWS, CLEVELAND, OHIO.

Claim.—1. The combination, with the hull of a vessel having suitable hatchways, of a frame carrying a winding drum, said frame being adapted to span the hatchway and rest upon the hatch coaming, means for anchoring the frame, and scrapers within the hold of the vessel arranged to be operated by said wind drum. Five claims.

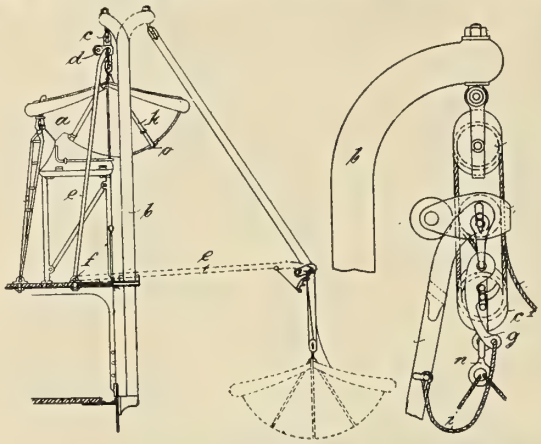
757,926. PILE DRIVER. JOHN H. HOPKINS, PUNXSUTAWNEY, PA. Two claims.

757,960. PILE-DRIVING APPARATUS. HIRAM W. PHILLIPS, QUINCY, MASS. Three claims.

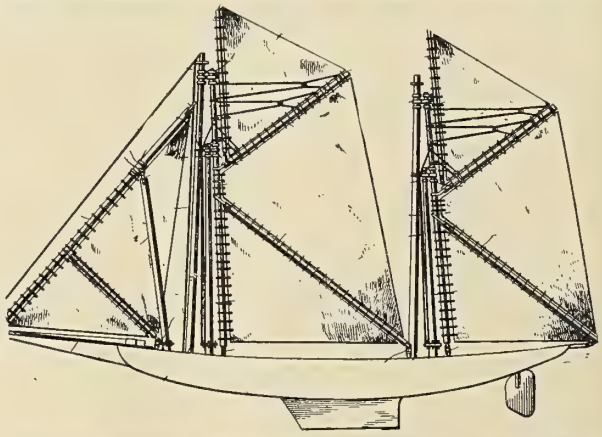
758,043. DEVICE FOR LOWERING LIFE BOATS. JULIUS F. BECKER, ELBING, GERMANY.

Claim.—1. In a device for lowering life boats, the combination of davits *b*, a pulley block *c* suspended by each davit *b*, pulley blocks *c'*, a bolt suspended by the pulley blocks *c'*, ropes *h* passing round the pulleys of each pair of blocks *c* and *c'*, booms *e* turnable around their ends *f* and inclined somewhat outward in the normal position of the boat, a sister block *d* fixed to each boom, said sister block being provided with pulleys for guiding the ropes *h* and hooks *h* and hook *g* for suspending the blocks *c'* to the sister blocks *d*. Five claims.

758,171. RIG FOR SAILING VESSELS. BYRON W. COLLINS, EVANSTON, ILL.



Claim.—1. A fore-and-aft-rigged vessel having a sail-supporting arm connected to the luff or fore leech of the sail and adjustable to arrange the sail in a plane inclined with respect to the horizontal and outboard from the vessel to thereby permit the wind pressure to exercise a lifting tendency on the sail. Twenty-three claims.



Extra Man in Engine Room.

Thomas H. Barrett and James A. Dumont, United States local steam-vessel inspectors at the port of New York, have sent to the superintendents of all ferry companies hereabouts the following letter:

GENTLEMEN: In view of the sudden death of the engineer of the Grand street ferryboat *America*, while on the passage from New York to Brooklyn, with no one at hand to answer the bells of the pilot when the steamer was entering her slip, it is respectfully suggested that you hereafter make provision that there shall always be in the engine room an oiler or fireman capable of acting in such an emergency as this.

A similar casualty in the case of a pilot of a ferry steamer a few years ago caused the Board of Supervising Inspectors to enact a rule as follows: (Section 8, Rule V.).

"All passenger and ferry steamers shall, in addition to the regular pilot or watch, have one of the crew also on watch in or near the pilot house; and this rule applies to all steamers navigating in the night time."

In the absence of a similar rule in the case of engineers of passenger or ferry steamers, this board feels that it is only necessary for it to make the suggestion herein, with the expectation that it will be as cheerfully responded to as though it had the force of statute law.

All the companies announced that they would comply with the suggestion of the inspectors. It is said that Secretary Cortelyou will have a bill introduced at the next session of congress requiring all ferryboats to have an extra engineer always on duty.